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KAVANAUGH 1987

APA-TECH 49

The Amateur Press Association by and for
the members of General Technics
("Yeah... yeah, that's the ticket!")

[illegible]

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The deadline for **APA-TECH 50** is Wednesday, All Fools' Day in Kalamazoo.

The copy count is 30 and minimum required activity is two pages every four months (and our axes are so sharp...).

I've no information on the current status of accounts; if you're unsure, why not send some money?

All's quiet on this watch: lots o' stuff came in and **no one** had to be dropped!*(However, Alice, Sheila, and Tullio are being put on warning for **next** issue.) We thank Annette for the cover, since my human associate here has come up dry once again for cover ideas. [Wahllll... I got things on me mind... -- gjr] Take care and sense you in the ether!

* which is why I skipped doing the roster this time...

Shal.

And Now a Word From
Linda Struwe Matsushita
coming to you from
2 - 15 - 1 Kosobe #302
Takatsuki, Osaka 569 JAPAN

Never prone to do something today that couldn't be put off until tomorrow.. or the day after...I've put off writing this for as long as possible. But I can hear the sounds of an ax being honed to fine sharpness in the distance. Sound takes a while to travel though, so I'll probably still be late.

An apology to start with. I didn't realize - or rather, I'd forgotten - that standard paper sizes are different here. Henceforth I'll probably leave copying to Stateside Operations.

Several people have asked several questions in the intervening months since last I wrote. I will attempt to answer them, but offer no guarantees.

The most oft asked question is how long we'll be here. (I usually ask Yas that at least twice a week.) Personally, I expect to be here for the next decade or so. But I'm hoping for a max of 2-3 more years. Since business is booming here and, let's face it, it's not in the States, there's considerably more job security here. Yas is very "Japanese" in his attitudes toward employment. The corollary to this is he would like to stay with one company for his entire career.

Since he's working for IBM, it would seem to be easy enough to get transferred to a U.S. location. Alas, seeming is not being. IBM, US and IBM, Japan function as two independent companies, and a transfer between the two is unprecedented. Not to mention that IBM, US is currently trying to lose several thousand employees. Yas' managers are trying to arrange some kind of transfer, even if it's only a temporary assignment so he can make his own contacts. So for the present it's a game of wait and see.

ON KANJI

Kanji, I think, will be around for a long time to come. Like the English, the Japanese are traditionalists. As someone has already mentioned in this august journal, computers can now handle kanji. Praise be to the Micro Chip. The keyboard uses the hiragana characters (50). So you have to type in a word (or phrase if the machine is really smart) using hiragana. Then press the conversion button to get the kanji. You have to go slowly (a word at a time) because often there'll be more than one possible kanji. The computer gives you it's choice, but you can look at the other options and choose the one you want. You can also convert to katakana in the same way. Some machines (like my word processor) are equipped to handle romanji also. So you can type in a word using Roman letters, convert to hiragana, convert to kanji.

When writing kanji by hand, any pen will do. Fine points are a bit easier for the most complex characters (some have 20+ strokes). The trick is in the stroke order. Penmanship is taught in the elementary schools, and I have the feeling it's taken much more seriously than it is in the American schools.

STANDARD TOPIC #17c/2

The only way to know the pronunciation or meaning of a kanji character is to have memorized it sometime before. So yes, there is a lot of rote learning in school. But most of this doesn't come so much from the writing system as it does from the influence of the Occupation Armies after WWII.

The school system was patterned after the European system with it's

periodic achievement tests. The major tests are for entrance into jr. high, high school and college. More than anything else, these tests will determine which schools you will go to which in turn will determine which company will hire you. There are waiting lists and tests to get into nursery school!

Kids here are faced with the possibility of determining their entire life at the age of 13 because of these exams. Since so much depends on these exams, the school curriculum caters to the exams. Creativity and originality can't be tested for. Names and dates can. So the entire curriculum stresses memorization and skills for passing the exams.

Japan is only just beginning to see the trap they're in. There's currently no plan to phase out the exams or to modify them in any way. In fact, the 'examination hell' is almost considered to be a kind of rite of passage. The Ministry of Education is a federal branch, so everyone uses the exact same (government approved) books and learns the exact same things. There's no room for originality in the system.

A COUNTRY'S OWN IMAGE

It's hard to judge the self-confidence of the Japanese. On one hand, they feel they are the superior race. I've even heard the theory that the Japanese are the next step in human evolution. On the other hand, they remember the resounding defeat of WWII.

There's a cultural tendency to put everything in ranking order. The society isn't very far from it's feudalistic history, and even today rank distinctions are rigidly maintained. When first meeting, business cards are ceremoniously exchanged. Among other things, the card tells your company and your position in the company -- pegging exactly where on the ladder you sit. This information is vital, because in the accompanying bowing, the lower ranked guy bows deeper. The relative positions will also determine the vocabulary each person will use.

Currently, Japan ranks America above itself, mostly due to military and economic clout. The inferiority complex we see isn't as deep as it may appear to be. Cultural assumptions have been put into your prospective. I believe it's more a case of accepting, for now, one's current position in the scheme of things. The Japanese have collectively been working like dogs for the past 40 years to improve their position among the nations of the world. And have done a pretty good job of it so far.

Most of the defeatist rhetoric is also cultural. It is extremely rude to admit that, through your own efforts, you can do something well. Usually one denies having any skill at all. If it's necessary to acknowledge some proficiency, one foists the credit on someone else (i.e.: I had a good teacher.)

A QUESTION OF GIRI

Giri(義理) duty, obligation, justice

More specifically, it's social obligations.

Even more specifically, there's no translation.

Giri encompasses every aspect of human interaction. It's saying good morning to your neighbors; bringing gifts for family, friends and co-workers when you travel; year end monetary gifts to children, your gardener, the superintendent; sending semi-annual greeting cards. The list goes on. Generally, giri is doing something because Society expects it of you, not because you want to do it particularly. As far as I can tell, we do the same types of things in the States, but just don't have a single word for it.

Truthfully, I don't understand what you mean by someone who is "starting one of these" giri relationships. If you could be more specific, I might be able to tell you more.

Some general giri things to do:

When visiting someone's house, it's customary to bring a gift - usually food.

When a guest arrives, you immediately serve tea, and perhaps cakes or biscuits or such like food.

If the guests are men, the wife answers the door, greets, serves tea, and quietly disappears - men and women don't mix socially -- but that's a bit extreme for Americans.

I wouldn't worry too much about responding properly. Treat your Japanese friend the same way you would treat an American friend. S/He's probably even more worried than you are about what to do. If nothing else, your friend might get a backlog of amusing anecdotes to tell the folks back home.

WE NEVER CLOSE

Guy W., you mentioned a possible trip to this locale in the future. Yas and I have a general open house policy - any visitors are welcome any time. If you have some time, by all means stop by. Takatsuki is a good staging ground in the Kansai, being less than 30 min. from Osaka or Kyoto and 50 min. from Kobe.

Drive....in Japan....are you mad?!?! You couldn't get me behind the wheel of a car here. Trains are more convenient, easy to use, run on time, and almost always faster. You also don't have to worry about where to park the silly things. If you do want to drive, you'll need to get an international license in the States.

I'm 99.9% sure the chef was bribed to give you the blow fish poison. You need a special license to be a 'blow fish chef' and masters have been known to commit suicide if a customer is accidentally poisoned.

IN BRIEF

We are nowhere near the recent volcano. We've been in Takatsuki for over a year and there have been only 1 or 2 slight tremors. In Kobe tremors are a bit more frequent. Tokyo averages 5-10 a day, but most are quite unnoticeable.

Okonomiyaki is also known as Japanese pizza. I think this comes from an effort to match up all Japanese foods to a Western one. It is, really, nothing like pizza. Quiche is a good parallel. I've always thought of it as Japanese pancakes.

The name of my mansion (apt. bldg.) is Takatsuki Grand Heights.

Apparently, depending on local dialect, the 'i' in Matsushita can be pronounced or not. My in-laws in Tokyo do not pronounce it. My in-laws in Kobe do. When Yas and I were introduced, he pronounced the 'i', so that's how I say it.

Dave I took the EIT just before graduating. It was biased towards ME, but that was my major so there wasn't anything unexpected on it for me. The EE questions were the hardest part for me.

Rolf Auto everything cameras are nice, but there is a certain art in knowing where to point the things. I've seen more pictures with the tree in focus than with the people standing in front of the tree in focus.

Susannah According to my one and only class in child psychology, there is absolutely no problem with kids learning and using more than one language. By and large, it is easier to pick up languages in the pre-adolescent years, and kids seem to intuitively know when to use which language (speaking Czech to Grandma and English to playmates). Yas spoke Japanese almost exclusively at home and English at school. He's fluent in both languages. All in all, it seems as if the teacher is looking for outlandish reasons to excuse her ineffectiveness at reaching a captive audience.

Bonnie Am I the youngest?!? My birthday is in July, so you are my senior by a few months. But Donna is my younger sister by 3 years. She wins the prize.

Valli How'll you get your zines in Milan? Presumably the same way I get them in Japan -- in a plain brown envelope, hand addressed. I've occasionally noted small tears in the envelopes, but I think that's just to check that it's

really printed matter. So far none have been opened for inspection. (If any were, they would have been resealed with tape that says "opened for inspection by Customs".)

Donna & Tullio A few ideas for streamlining Ishercons....

When you buy food, put a piece of masking tape on it with the date and meal it is intended for. If you have multiple packages of something (like bacon) add how many pkgs go with that meal. i.e.: breakfast 12/30 #2 of 4

For chores, a multiple system may be best. Put up a KP chart for volunteers. This way everyone has a shot at showing their forte. Set a deadline for signups. At the deadline, take all remaining names - by lottery - and fill the remaining positions. Everyone will know in advance what they are expected to do for the duration of the party.

You can't be everywhere. For setting up auxiliary equipment, make a floor plan of the house - rough sketch of each floor, nothing fancy. Assign each purpose to a room or part of a room. "Computer Room Here" "Video Here" are pretty self-explanatory.

Post the planned menu for the entire party, including the quantity of ingredients for each meal (i.e.: 4 lbs bacon). Then the cooks will know how much of what to look for.

Hard to do for large groups, but perhaps you could try to put the meals on a time schedule so you don't have the stray nibblers making meals by 2's and 3's.

AND TO CONCLUDE

Teddy Ruxpin made his debut here in time for Christmas. He speaks in Japanese, but his book is bilingual. Not just another pretty face, this kid's a scholar.

'Til next time....

Linda



SOLID MISH-MASH

A contribution to ApaTech 49 by Roxanne Meida Shields of 4309 Drowfield Dr., Trotwood, OH 45426 (513) 837-4165 At least that's where I live right now.

(NOTE: I wrote the following for Issue 48, but it didn't get mailed.)

It's January and I Haven't Needed a Snow Shovel Yet

Well, I saw a lot of you at Isher so much of this will be rehash, but so what. Read it anyway.

1986 was a Real Good Year for Scott and me. I doubt we'll have another as good soon, maybe not ever. We each got new, paying-real-money jobs, we got two new cars, a new place to live, took a great vacation (see Issue 44), acquired miscellaneous other "Yuppie" gizmos, and even managed to save a little money. (Now for a chorus of "Lord, it's hard to be humble...")

On the downside, two great-uncles and a great-aunt died. For two out of three it was more a relief, but the third was only 66 and he wasn't supposed to die quite yet. Oh, well.

Scott has been "supposed to" go to Mexico approximately every week since mid-October. So far he has actually gone once for six days. He was supposed to go last Monday (Jan 12) and next Monday (Jan 19) but both have been postponed and now he's supposed to go on Jan 26. I'll believe it when I see it. He has also been on the job for one year now, and has missed his 30-day, 90-day, 6-month and 1-year job/salary reviews. This can't reflect well on his boss, but there's nothing we can do about it.

My job is going middling all right. I have interpersonal problems with my boss, but am trying to work around them. The big projects we have been working lots of overtime on have just about wound down. It will be hard learning to live on a normal paycheck again.

We went to Isher, arriving just after midnight on Friday night/Saturday morning. It takes about five and a half hours to drive to Kalamazoo from here. Although the distance is quite a bit shorter, it's about the same as to Chicago. This is because there is no direct freeway from here to Kazoo. We have to wind our way on US 30 around Fort Wayne between I-75 and I-69. As US 30 is a normal four-lane road around Fort Wayne, it slows us down. However, it does give us a good halfway point to eat at.

It seemed I spent most of the time at Isher discussing the having/raising/etc. of babies/small children with just about everyone. Between having my sister here for a few days, visiting Scott's parents (with Scott's sister and her brood there too) and Isher, I have been around a lot of little kids and I discovered some new things about child raising and as usual I will talk about them here. Feel free to tell me all the places I'm wrong (I know you will). Fortunately or not, all the children I saw were girls, ranging in age from 9 months to five years. I will therefore refer to the child in the female, as that's what they were.

1. It is good to have grandparents in close proximity if you have children. Parents who know they can leave the child in good hands on short notice tend to be more relaxed. They are not as likely to abandon the child on anyone who looks like s/he might babysit for a while, just to be away from them.
 2. The shorter the child's leash, the more enjoyable she is to be around. That is, the closer the parent's attention to the child, whether obvious or not, the less the child will misbehave, and the less, as the observer, I will wonder whether or not to discipline the child myself. I had one parent tell me not to discipline the child, and two others tell me to go ahead. One even added that the child might respond to me better, as I was not the parent. The implication seemed (to me) to be that both the parent and the child knew who ruled their relationship, and only another might be able to rule the child.
 3. Changing diapers isn't that bad, provided the child isn't sick.
 4. A sick child is the pits.
 5. It is possible to read to 9 month olds.
 6. Tiny babies don't stay that way long, and when they aren't tiny at first, they REALLY don't stay that way long. (Lori's baby at 9 months old weighed 18+ pounds, was 30 inches tall, and was more the size of a 18 month. This is my "baby" niece?!!)
 7. Kids are not easily broken, despite internal adult emotions to the contrary. If a kid falls, an adult will usually react worse than the kid, and this is bad. For example: Kid falls down. Adult rushes over, picks up child, asks if child is okay. Fine. What does kid learn? Falling over (a) gets attention from adult; (b) causes a big commotion; and (c) doesn't hurt much. Conclusion: Falling down is a great way to get attention! Problem: Those adults stop paying attention when child falls, and soon don't notice when the child really is hurt. Solution: Don't pay attention to a child falling, unless s/he starts crying or acting dazed first.
 8. People over 18 who do not have children make inconsistent baby-sitters.
 9. Parents who have more than one child do better. I think this is because they just don't have time to put up with the bullshit one child can produce. A single child will get dinner even after he dumps his on the floor; a child in a family will learn that dumping the dish means no food for him. Plus he isn't used to all the toys being "his."
- Okay, how does this integrate practically into children at GT events, you ask? Rules need to be created. Rules I would suggest or second include:
- A. No unaccompanied children anywhere, at any time. Such children, and their parents, should be summarily ejected from that event.
 - B. No unpaid babysitting. I got \$2 an hour ten years ago; my rates have since gone up. Paid babysitting only by contract.
 - C. Only parents change diapers on their own children. If the child is currently in the midst of potty-training, put diapers on him/her for the

duration, or leave them at Grandma's.

D. Only parents feed their own children.

E. Establish child-safe zones and child-prohibited zones.

F. Sleep-over children sleep with their own parents. Possibly in the same sleeping bag, if space is that short.

G. Computers must be in the child-prohibited area.

H. Parents will pay full restitution for any damage the child does, even if it means buying a new 512K Mac with 30 Meg hard drive to replace the one trashed. Or paying to clean the rug the child urinated on. Or to replace the curtains Junior sliced with the scissors. Ad infinitum.

Different GT events will of course have different parameters. At HamFest, I am expecting three child-prohibited areas: the kitchen, the computer room, and my bedroom. There will be one child-safe area: the dining room. Gray areas are the living room, bathroom and the second bedroom. Children must go with their parents to the HamFest. I WILL NOT tolerate children left here without their parents. The potential problems are mind-boggling. Adults will be asked to be circumspect and not leave many small items (especially IC's, etc.) around. Nevertheless, the child will be to blame should he ingest such an object.

Well known anecdote: I saw my first X-ray at age 5 after my sister, age 2, put an open safety pin [the little gold kind] in her mouth, and breathed in while my mom tried to remove it. The pin came from a dress tag my mom had removed from her dress moments before and put on a table supposedly out of Lori's reach. Lori had to be taken to the hospital, where a tube was inserted into her lungs (carefully, so as not to move the pin to a position to puncture the lung) and then very tiny forceps on a long shaft were inserted inside the tube to remove the pin. I do not want any visitors to go through what my parents did, nor any children to go through what my sister did. In analyzing this incident, we have long established that this was Lori's fault. I will take that view in any such incident.

Hamfest 1987

Hamfest is only ^{three} five months away and many of you are making your travel plans for next year already. I want to explain a few things and let you know what's going on from our end.

First, last year's Hamfest went real well. Everyone had a good time, and it wasn't too crowded. Therefore, we are doing a few things to ensure this happens again. In the interest of having as few hurt feelings as possible, I want to explain everything publicly.

1. Our house is a fairly nice three bedroom ranch. It has an attached one car garage and no basement. We feel that sixteen people is the maximum it can sleep comfortably. It will be worse if the weather isn't nice.

2. Every hotel within a fifty mile radius has been booked solid for Hamfest since August. I know because I checked. Therefore:

3. We are making staying overnight at Hamfest an Invitation Only party. If more than we invite show up, we have nowhere for them to stay AT ALL. While it would be nice to make up a list of only those HamFesters that both Scott and I like, we aren't doing that. We are inviting everyone who came last year, plus Bob and Connie, Barry because he was notably missing, Donna and Tullio who we'd like to see and who'd like to come, Valli and Joa if they're still around, because they are Real Bonafide Hams, who would come for the HamFest and not just to socialize.

That's It. If previous attendees tell me in time that they can't come, I will invite additional people to take their place(s). Please do not take it upon yourselves to invite people that you "know would like to come." Lots of people would like to come, but unfortunately we don't have lots of room.

Note: For those who know the gory details of our problems, Scott has agreed to host HamFest no matter how well we happen to be getting along by then.

Now that that's over with, I can get on with the rest of the zine.

NEW STUFF FOR ISSUE #49

The past four weeks have been very enjoyable, and quite confusing. Scott went to Texas/Mexico as planned on January 26. I hardly noticed he was gone the first few days. The first weekend, I went up to Chicago, stayed with Mike and Alice, and did quite a bit of genealogy research at the Newberry Library. (The Newberry is one of THE places to go, along with the LDS library in Salt Lake City, for genealogical research.)

The next weekend, I was feeling even more lonesome, so I went up to see Donna and the folks in Kalamazoo. Marty had a party for Chinese New Year, and Mike and Alice also came, so again it was a great time. Unfortunately, I committed a Major Indiscretion, and that will haunt us for quite a while.

The following weekend, Inland paid for me to go down to Texas to see Scott. It was very nice to leave 25° weather here and arrive in 80+° weather there. We sat in the hotel's jacuzzi, swam, went to the beach on South Padre Island, went shopping in Matamoros, Mexico, and generally had a great time.

In Matamoros, the "subdivisions" look like the slums you see on PBS specials on the third world. The incongruous part is that in Matamoros you will see a (to my eyes) broken down shack built of 2 x 4's with a goat tied to the porch, with a 1986 car outside and the children dressed in designer jeans. It takes a long while to stop putting my (Northern Midwest) values on their housing. Logically, there is absolutely no reason to build a sturdier house. The weather is always pretty warm (It was 86° on February 14) and, since the power supply in Matamoros leaves a lot to be desired, the average person can't build a well-insulated house and assume he can air-condition it. The plywood and cinder-block "shacks" actually make a lot of sense, in context. But it's hard to get used to.

The thing that could be helped is the smell. There is no sewage treatment, and every ditch is a potential open sewer. Scott says that even in the Inland plant there is a wastebasket in every stall, because the sewer system cannot handle paper (think about it...). I think the government of Mexico

should require that American companies who go there to build sewage treatment plants. This would help the companies as much as Mexico, and the companies could get great PR out of it. I expect it breaks down when we start asking who would control the operation of the plants. Oh, well.

Because of the exchange rate (1,015 pesos to the dollar), I was able to buy yarn there for about 1/3 the cost of the same yarn in Dayton. I didn't have any patterns with me, so I just bought tons of it and figured I would find something to make from it. I had a lot of fun buying it, too, because the man there spoke some English and I spoke some Spanish (I know my numbers and "dame" [give me] but not my colors).

The Mexican economy has nose-dived in the past ten years. When I took Spanish in high school, we learned that the peso was worth about a nickel. It is now worth about 1/10 of a cent, or about 1/50 of its value in 1977. Imagine a dollar worth 2 cents, or a twenty dollar bill to buy a newspaper. That's what the exchange rate has done in Mexico. True Mexican inflation hasn't been nearly as bad. You can get a \$1.50 hamburger for around 500 pesos. That's why American companies can cross the border and get labor for cents an hour. They pay a very good Mexican wage, say 600 pesos an hour, (which in 1977 would have been \$30/hour) which today translates to only 60 cents/hour.

South Padre Island (Texas) is a great place to go for a vacation. The sand is about the color and consistency of sugar. The Gulf is pretty warm even in February. It makes an ideal Spring Break location. The island is about a half mile off the mainland, and 90% of the locals live on the mainland, so you could party long and loud and not bother anybody. The primary buildings on the island are hotels and (good) restaurant/bars. Plan on eating lots of seafood if you go there. Their idea of what to do with a steak leaves a lot to be desired (I MAYBE put that much pepper in my chili).

On the movie front, I finally got to see "Mannequin" which stars the only star (Andrew McCarthy) whom I have gotten drooly over (well, since Bobby Sherman when I was ten, anyway). It was very satisfying for the Movie Fan in me, but quite disconcerting because A.M.'s character's former girlfriend happened to be named Roxie Shield. I should at least get to meet him for that, shouldn't I?

Mailing comments on issue 46:

Cover: Haven't I seen this somewhere before? 555 Times: Goodbye, Deadwood.

At Home on the Range: Gas or electric? Your mention of GreenPeace got me thinking (always a bad sign). At a younger age I was militantly opposed to the killing of any such hunted animal, including deer, moose, elk, rabbits (bunnies!), you name it. Having spent numerous years in the next-door-to-wilderness of Upper Michigan, I am now much more cynical (?) about the whole thing. In Michigan, there is 1 deer for every four humans. There are several moose, hundreds of elk and possibly millions of rabbits. Every year thousands of these animals are killed by non-hunters behaving stupidly, combined with stupid animal behavior. (Worst are the back-to-nature-ites on ATV's.) I feel much better about organized, monitored harvesting of these animals to help keep humans and the rest of the animal species from starvation. And GreenPeace has no more right to sink a foreign

ship because it doesn't like what it's doing than an Iranian has to blow up an embassy because they don't like what they're doing. When GreenPeace merely harrassed the whalers, it was one thing, but when they attack violently, they become hypocrites and lose my support entirely. It's the same contrast as picketing quietly vs. bombing abortion clinics.

Re yr ct Bill-EI: Maybe I'm glad I can't eat yogurt. Re Rug Rats: My family seems to solve that by just not having boys. (4 nieces, 0 nephews.) When I was young, they explained very clearly what happened to girls every month. That was fine, until about four years later when I found out that boys had NOTHING AT ALL, EVER. Saying I was outraged is to completely underestimate the emotion involved.

Amorphous Abstractions--Finally! A zine title which describes the article!

//Sign us up for the GT/PFRC campout. We'll be at McLain and/or Fort Wilkins (maybe the Porkies, who knows?) the week before. But leave the current incarnation of PFRC out of it, OK?//Isn't it a shame that they never let you read the really good stuff?

Letter From Easton--Very interesting, but there's no way I can answer any of those questions responsibly (ok, so that has rarely stopped me before, but it has this time).

Transporter Topics--Good luck on the novel! I've always wanted to read a book by someone I knew before he was a published novelist.//Re new cartoons: Why aren't you sleeping on Saturday mornings?

Invisible Starship--I know why you can't find any women; you're never in one place long enough!//Thanks for the review of what really happened at Chernobyl. My initial reading evoked comments of "Gack!" and "I'm glad I wasn't there!" Also, an extra 3000 cancer deaths is an interesting number. Do they mean in Russia, world wide, or within a hundred mile radius?//

What college is Bexley Hall at? How many people live(d) in it? Was the cat a resident, or a commuting member?//On TV the other day, while channel changing so I'm not sure what news program it was on, someone stated authoritatively that 85% of "Yuppie" executives feel they were never part of a group in high school.

This Side of Eden (Twollee?)--I agree completely on the subject of autographs.//Otherwise, RAEBNC.

Again MMC--It is beginning to appear from my limited Christmas/Isher observations that the kid on the short leash is the kid that's nice to be around. The kid who gets what s/he wants is just insufferable, and non-parents are ready to strangle him/her within just a couple of hours. The kid who can play his/her parents against each other ("Daddy said I could... Mommy lets me...") is the child of careless parents. Moral of the story: Parents exist to keep children from doing/getting what they want. Moral #2: Being a parent often is not fun, because YOU have to be cop, judge, jury and warden. And no time off for good behavior. Moral #3: Dad and Mom have to agree on rules and punishment. I know I could produce a child, but whether I could be a (good) parent, and especially a good part of a good parenting team, is another question.

CRUMBCRUNCHERS, INC.

by Susannah West and David Powell

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February, 1987

Our thoughts this month are tending towards two people who cannot contribute to this APA, neither of them being able to read or write yet....Including children at Ishercon was an experiment, and in the way of many experiments, it was both successful and unsuccessful at the same time. However, regardless of the outcome, both of us extend our sincere appreciation to Donna and Tullio for assuring us that Marlene would be welcome.

We know that the issue has been discussed, rediscussed and discussed some more. Most of you probably feel it should be laid to rest. However, as we were unable to participate in the discussion, please bear with us and let us be a baby advocates for a moment. We will speak mainly of Marlene, as she is the child we know best.

We gather that Marlene irritated a number of people more than a little. When children are present at what is for the most part an adults-only event, there will *always* be problems. When toddlers are present in what is for the most part an adults-only house, there will *always* be problems. There are many events that we had to give up after Marlene was born - concerts, our IBM-PC user's group and small business SIG, even movies. So if friends ask us to participate in something that they feel would not be right for Marlene, we would neither be hurt nor offended to be told that. (Yes, of course there are baby-sitters, but we hesitate to invite a sitter into our home, especially a teenager, given the expensive computer equipment we have sitting out in the open. And for the several hours or more that an excursion to Cincinnati or elsewhere entails, hiring a sitter is impractical.)

We tend to think of children as miniature adults. They are not. They may seem noisy, obnoxious and constantly underfoot, they are also being their own exuberant selves, constantly exploring their environment. They get frustrated easily because they don't yet possess the language skills to communicate what they really want to say. Just like adults, they get tired, cranky, or hungry, but because they still have trouble expressing themselves, they're more vocal about it than you or I would be. Not being able to take a nap just makes matters worse, even though they themselves may be the ones who adamantly refused to nap. (And they may decide to stay awake as long as possible, just to spite you, getting more and more cranky and upset by the minute.)

Like any small animal, they learn from experience what they can and cannot do. They have to be told (and told and TOLD) what things it is not safe or good to mess with. Yes, parents must be vigilant, but we are only human and it is impossible to protect a child totally from his/her environment.

For example, this Christmas, while visiting Susannah's parents, Marlene drank part of a bottle of cologne. Susannah had put her to bed and waited outside the room for several minutes until it seemed that she was settling down to sleep. Her mistake was in not waiting long enough for her to go to sleep; instead of going to sleep, she got out of bed, and by pushing a stool over to the wall and standing on it, had turned on the light. She spied the bottle of cologne on the vanity, and decided to sample it. The cologne, by the way, was purely for decoration, and we hadn't even realized it was there.

No harm came of this incident, fortunately. We called Poison Control, who advised us to "keep an eye on her." Yes, she was a trifle drunk and staggered around a good bit. The most painful part was that Susannah's mom spoke sharply to us and made critical remarks about our parenting; from this we got the distinct impression that the three of us had worn out our welcome. So you see, even grandparents who have grandchildren in their home regularly can find them irritating.

By our adult standards, children can definitely be a bit bizarre, but they are just being children. They can't be put away in a box like a game and stuck on a shelf, nor put in a room by themselves and expected to occupy themselves for hours on end, as convenient as that would be. They can be contained better in an environment they're familiar with than in a strange one, but only if they have something to do. We know from experience that Marlene can wreak as much havoc in her own bedroom as she could in anybody else's home!

We're not trying to say that children should be allowed to run amok. Far from it. We're just trying to stand up for them as much as we can, though we're no longer children ourselves. Marlene is infinitely precious to us, and in bringing her with us, we wanted to share her with you.

But there is no need to worry overmuch. The baby who's just starting to walk will be experimenting with words in a

few more months. And not too much more time will pass before he/she is stringing together sentences. The Terrible Two-er will soon be three, and then in another year four - still a little kid, but a bit more controlled and sedate, able to communicate better, a thinking individual. The next time you see him/her, it'll probably be like meeting a whole new person.

There is a fine line between crunching a child and not disciplining him/her at all. All of us who have children want to be perfect parents and have a kid we can be proud of. Especially those of us who have had to wait a long time to start our families feel that much more is at stake and much more expected of us, because we are "older and wiser." But trying to be a perfect parent can ultimately spell disaster, both for us and for the kid - maybe not now, but a few years or more down the road....It's much better to have a kid who's just 'okay' than one who's perfect!

Yes, being a parent can certainly change you. You start being able to see the world from a child's-eye viewpoint. You start noticing things you know will delight them. You watch "Sesame Street" and "Mister Rogers' Neighborhood" with them, and discover that even the Neighborhood of Make-Believe and King Friday XIII can be enjoyed. Where once your tastes ran to rock music, you now listen to and enjoy catchy children's tunes. Sometimes, in your exuberance, you want to share these with other people, who, because they aren't in your shoes, don't understand....

We've found this very difficult to write, and it has taken us a long time to think just what we wanted to say. (This is the second time we've written it, in fact - we spent all last Saturday evening writing, only to have the computer eat the work next morning!). It would be wrong of us to apologize for Marlene for simply being herself. But neither do we want anyone to think that we are criticizing them directly; in any event, we couldn't do this, as we're not aware of what was or was not said about the children.... --Susannah and David

And now....on a less intense subject....a brief note from Susannah

Finally, we've had some winter weather! Monday, we woke to the incessant, faint pinging of tiny ice pellets, hitting the windows. The sidewalks, the cars, our porch steps, the trash we'd put out the evening before - all were coated with a layer of ice. When Marlene and I walked to the post office to pick up our mail, the ice blew in our eyes...Marlene held her eyes closed tight and cried, because she couldn't see....Today, we woke to see the ground covered with a fine layer of snow, and the tops of all the tree limbs outlined in white. I stepped outside to get the mop off the back porch at about 7 AM and listened to the quiet. It was broken only by the whirring call of a woodpecker in the woods down by Red Oak Creek, the cawing of a crow, and the swish of a truck passing by on Second Street. A few fine flakes were still falling, hardly visible unless I stared a long time....I brought the mop inside, filled the bucket with hot water and a little Lysol, and scrubbed the kitchen floor....Soon I heard Marlene's door creak open, heard her morning greeting of, "Mommy, where are you?" and the day had begun.

On other fronts: Our Mac and LaserWriter have lost their amateur status. David and I just completed an advertising brochure for an R/V show to be held at a mall near Columbus in April. It looked very classy, as the paper we used had already been preprinted with a reproduction of a watercolor of the interior of the mall. We are learning as quickly as we can; one of the reasons we got the Mac and LaserWriter was so we could do work of this sort.

The house I mentioned last time may be a dream and nothing more; I am working on learning how to live in five rooms, instead of merely complaining how crowded we are. I know we could utilize space better, not to mention getting rid of white elephants and unused furniture. We are disappointed, but such is life. Now, as Marlene is occupied eating her Malt-o-Meal, a few mailing comments!

COVER: Classy!

JAMIE: I found your comments about LATEX fascinating, as I had a brief experience inserting typesetting codes into a manuscript - this was a job for F&W Publishing (Writer's Digest Books, among other things) and it was by far the most aggravating, frustrating job I'd ever undertaken. Being my first encounter, I had more problems than others more familiar would have, I expect, especially as I didn't have the benefit of attending the training session F&W provides most of its freelance word processors with....Though I did get paid \$300+ for the job, I also spent several dollars in long-distance phone calls to Cincinnati, and spent 10+ hours a day in front of the computer for a week. My guess was that F&W was really crunched for time, and being desperate, asked me to do the job. (It's been a year and a half, and they haven't asked me again - I guess I was a big disappointment to them!)

GUY C.: Your comments on *The Arm of the Starfish* prompted me to go to the bookcase and search out my copy of the book. Though I've read it many times, it is always fresh. This time I was especially struck by the fact that, although it was written 20 years ago, the entire feel of the book is incredibly contemporary.

I remember my fourth grade teacher reading one of the Mushroom Planet books to our class....My favorite Eleanor Cameron book, however, is *A Room Made of Windows*, a story (set in the 1920s) about a girl who likes to write, meets another writer a few years older than she, and through her, is encouraged to submit a story to ST. NICHOLAS. Throughout the book there also runs her fierce resentment of her widowed mother's boyfriend, and her desperate attempt

to cling to the memory of her father.

BONNIE: Getting older is a funny thing. I don't have any illusions that I look sixteen, but sometimes I still feel that old. (Especially when I remember the painful times I had in high school.) Being inevitably carded whenever I go into a bar (which is very rare these days) really irks me. I had to put up with an under 21 badge at this year's Marcon, because I discovered to my intense chagrin that I'd left any identification with proof of age in another wallet....Even having a little kid in tow and crow's feet around the eyes doesn't exempt you.

BOB AND CONNIE: We too really enjoyed Christmas with Marlene. I was a bit surprised that she was quite polite about her presents, bringing them to me with a, "Open dis, Mommy," rather than tearing into it herself. We were probably all a bit inhibited in opening our packages, because my mom has always been such a stickler about not tearing wrapping paper and saving it for next year. Her favorite presents were probably a Tiny Tears type doll and hand-woven cradle. I got her a toy vacuum cleaner, hoping that when we clean the house, she'd use hers and let me use mine. No such luck!

ROLF: Sometimes I wonder whose side the post office is on! I wrote to an artist back in September, and when I didn't receive an answer in about a month's time, wrote again. This letter came back labeled unable to forward. I began to plot how I might possibly find this fellow's new address - through the Small Press Writers and Artists Organization, perhaps. Though I never got this far, I eventually heard from him in January - he had finally received the letter I wrote in September. The real mystery was that though he had changed apartments, his P.O. box number (which I'd addressed the letter to) had remained unchanged. My only guess is that, as I did include his street address, the clerk(s) who processed the letter looked at that rather than the box number. Having attended a bulk mailing seminar at the main post office when I lived in Rochester, New York (I was for a brief time the public information coordinator for the Landmark Society), and seeing how clerks must make split second decisions about where mail goes, I'm not surprised that this happened.

TO EVERYONE: Thanks for your comments concerning our friend Albert and his bilingual dilemma! We recently saw his mother and little sister Anna - no longer fourteen months old, but a year and a half (it's so easy to forget how quickly the months pass). True to form, she is starting to gabble, in Czech, of course. The thing that shocked me most was not that she was saying no English words - that didn't surprise me. What did surprise me was that she was almost as big as Marlene! (We hadn't seen her since she was a few months old, as whenever we'd visited she'd been sleeping, visiting relatives in Chicago, or more recently, spending time with her grandmother in Czechoslovakia!) As Marlene grows out of her clothes, they get handed down to Anna, and now I'm wondering whether she's not grown out of them before she receives them!

Well, "Sesame Street" is three-quarters over, a pot of split pea soup is simmering on the stove, and this disk is almost full. So I guess it's time to say farewell. (Oh, also included in this submission is an article from one of Dave's professional journals that he thought might interest you.) Be well and happy.....Susannah



The editor's page

Forest decline and a fortuitous accident

■ Accidental occurrences have often led to far-reaching consequences. The report of a recent accident in Austria strongly supports the premise of John Hamaker regarding the remedy and, by inference, the basic cause for the declining health of forests.

In *The Survival of Civilization*, John Hamaker, with Don Weaver, proposes that the gradual depletion of available soil minerals, by forests and other vegetation following the retreat of glacial advances, triggers the cycle of events that initiate a new glacial advance. (Hamaker-Weaver Publishers, P.O. Box 1961, Burlingame, CA 94010 USA, \$12.95 post-paid. Reviewed in this column in September 1983 and December 1983.) Without the minerals supplied by finely ground rock produced by glaciers and distributed worldwide by water and wind, soil microorganisms cannot supply these essential nutrients to the roots of vegetation. Weakened thereby, vegetation cannot absorb and buffer the CO_2 produced by oxygen-breathing organisms. Increasing CO_2 concentration in the atmosphere leads to a disproportionate heating of tropical regions and cooling of temperate regions, eventually leading to a new glaciation. Pollen evidence from past glacial periods suggests that the present 10,000-year-long interglacial period is in its rapidly closing terminal phase. Hamaker proposes that a massive remineralization program applying crushed rock (~ 200 mesh) to forests and crop lands could stave off the imminent devastation if applied soon enough and combined with a rigorous curtailment in the use of fossil fuels. The time for action is short, perhaps already past, because additional "greenhouse gas" emissions from increased tectonic activity forced by the pressure of polar ice buildup can make the process irreversible despite successful control of existing CO_2 emissions.

Despite extensive evidence supporting many aspects of the thesis, grant givers and recipients, both scientific and political, disdain to consider it. "Acid rain" seems to conveniently explain forest decline and a bogus "warming theory" seems sufficient to quell any serious examination of increasing atmospheric CO_2 while we proceed with the terminal rape of the planet.

■ The Austrian "accident" occurred five years ago when, during the resurfacing of a road, an area of sick forest became heavily coated with gravel dust.

Instead of sealing the fate of the affected area, however, the gravel dust rejuvenated it in clear contrast to the continuing decline in the adjacent area. This surprising result attracted considerable interest among scientists and public officials.

In a communication with the owner, Mr. Robert Schindele, I learned the following information. After purchasing the forest of spruce, Scotch fir, and beech trees, he decided to build a 1.5-mile-long road in it prior to felling the pines which were doing poorly. The area of the wood is about five hectares (12.3 acres), about 1000 feet above sea level. The metalling for the road was taken from two outcrops situated in the upper part of the wood. The stone in question is a kind of gneiss, a metamorphic type of rock identified as a migmatite amphibolite. When mechanically crushed, it fragments relatively easily into extremely hard particles that cause more wear and tear to loading machines than other materials. A great deal of dust was created during loading of trucks. Clouds of it drifted down the slope of the wood, covering all needles and leaves and the ground to a maximum depth of about 5–6 mm tapering off away from the source.

Within a few months, all sick fir trees became healthy and subsequently all of the trees recovered completely from damage caused by acid rain. They grow 50% better than before; the beech trees lose their leaves four weeks later than usual. Grass, herbs, blackberries, and raspberries grow like never before and the berries taste better than those from areas not exposed to the gravel dust. The deer population has grown and prefers the exuberantly growing grass.

Although the forest is in a protected area, the government has agreed to allow Mr. Schindele to produce 2.5 million tons of gravel dust for distribution and sale. In agriculture, it will be dispensed by fertilizer machines and in forests by helicopters. He expects in the latter case that it will eliminate the need for pesticides.

Chemical analysis of the gravel dust is: SiO_2 : 62.20%; Al_2O_3 : 18.33%; K_2O : 7.8%; Fe_2O_3 : 4.8%; CaO : 0.99%; MgO : 1.44%; plus trace Mn, Cu, Zn, Co, Mo, Cr, Ni, V, Cl, SO_4 , PO_4 ; $\text{N}(\text{NO}_3)$: 0.1 mg/100 g, $\text{N}(\text{Kjeldahl})$: 11.620 mg/100 g, $\text{N}(\text{organic})$: 11.17 mg/100 g; pH = 7.6.

In June of 1985, the Head of the Department of Ecosystem Research, Institute of Comparative Ethology, Austrian Academy of Science, visited the

wood and reported his findings to the Federal Ministry of Science and Research. Although he travelled to Melk with a certain skepticism he returned convinced of the effectiveness of the chance mineralization. From the needle growth on the pines and firs, and from the condition of the oldest branches, it could be seen that up to and including 1981 there was only a weak growth, but that in the next four years the needles grew very strongly. Among the pines there is now hardly any crown extinction or stork's nest development (acid rain effects). One pine, around 35 meters high, is in good health, which is unusual in that area. During the survey many pines in the surrounding area were seen to be in a pretty bad way.

It was seen that the trees nearest the loading area grew best; in more distant spots which had been covered with perhaps only 1 mm of dust, there was still a good growth which was, however, markedly less than where the layer was thick.

From the gneiss fragments which remained on the forest floor, it was seen that the type of stone tended to break down into smaller particles under external effects.

Samples of the stone taken to his laboratory ground easily but caused an unusually great deal of dust. Chemical analysis of the gneiss showed the lime content to be relatively low, but the nutritive substances and trace elements were present in sufficient to generous quantities.

■ In simple laboratory tests, garden soil and peat were mixed with a small amount of gneiss dust and lettuce seeds grown into seedlings. For comparison, the same thing was done with a great many other rock dusts. The growth was greatest where the gneiss dust was added. Although he cautioned that the growth might even out over time as the seedlings grow, there was no doubt that the gneiss dust has a positive effect on the development of the lettuce plants, especially when compared to the control group. Tests are continuing in the laboratory.

This dramatic example of forest remineralization is unlikely to reverse the present, perhaps studied, apathy toward the implications of soil mineral depletion. But I believe it imperative that it be added to the record.

The phenomena is not newly discovered, just studiously ignored. Hamaker (op. cit., p. 22) noted the work of Julius Hensel, who demonstrated in the 1890s that a mixture of ground stones representing a cross-section of all types of rocks would produce good yields of top-quality crops. Weaver, in *Supplemental Perspectives to The Survival of Civilization* (pp. 4-7), reviewed the findings of eleven researchers using crushed rock, N-P-K fertilizers, and

combinations on forest and crop lands. Great increases in fertility along with increased resistance to insects were experienced on poor soils with the addition of crushed rocks but little, if any, with N-P-K fertilizers alone. The work of O. D'Hotman De Villiers and colleagues using crushed rock on cane sugar fields on the "extremely impoverished free soils" of tropical Mauritius is particularly significant. Over a 25-year period of experimentation, De Villiers demonstrated increased yields up to 100% at an application rate of 180 tons/acre. Soybeans, millet, oats, and tomato plants could all be grown successfully in pure crushed basalt, "the mother rock from which almost all the soils of the colony are derived," exclusively fertilized with nitrogen (*International Sugar Journal*, Dec. 1961, pp. 363-364, and Jan. 1982, pp. 3-5). Forest trees and foodstuffs strikingly benefitted from large doses of crushed basalt on poor soils.

Laboratory experiments using highly dilute solutions of citric acid and nitric acid (which is formed from nitrogen fertilizers put in the soil) to extract minerals from the basalt leached out significant quantities of elements in first extracts, yet declining amounts in subsequent extracts. This provided a clear demonstration of the acidic fertilizer action which selectively leaches the soil elements from the soil rock as discussed by Hamaker (op. cit., chap. 2). This principle is further documented in many scientific studies including studies of the leaching effect of acid rain.

Incidentally, if you plan to try remineralizing your own garden or forest, you need not hold out for a migmatic or basaltic deposit. Any glacially derived rock dust should prove beneficial. Well, so much for insight. Remineralize your garden/farm/forest. It may literally be a life-saving act.

Fredrick I. Seitz

Life as a glueball

for APATECH 49

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I was going to write at length, but I did the mailing comments first and am burned out on writing. So, just a few odd comments....

Algebraic Topology is a neat subject! It involves the study of the algebraic structure of topological spaces. Some problems in topology may be very difficult to solve, but a corresponding group-theoretic problem may be very easy. The subject rests on *category theory*, a rather abstruse branch of mathematics. A category consists of a class of *objects* and a set of *morphisms* from one object to another. These morphisms must satisfy laws of identity, associativity, and composition. One common category is that of sets and functions. Another is the category of topological spaces (such as the real numbers from calculus) and continuous functions. Another is the category of groups and homomorphisms (no relation to "morphisms") Algebraic topology involves the construction of *functors* from the category of topological spaces and continuous functions to that of groups and homomorphisms. These take objects from the first category, "spaces," to objects in the second category, "groups." They also take morphisms from the first category, "functions," to morphisms in the second category, "homomorphisms," in a special way—they preserve identity, associativity, and composition. So to each topological space, a group is given, and to each function a homomorphism. Now by solving a problem in group theory (algebra) we solve a problem in topology as well! A very interesting subject!

A Polemic on education, part I

We hear in the press about the sad state of American education. We hear many theories about why things are bad and how we can make them better. Usually these theories require lots of money to be implemented. Invariably they never work. Yet we never hear about the *real* problem: the lack of motivation in our students.

Anyone who has children or has worked with them extensively (as I have) knows that infants and preschoolers are incredibly curious about themselves and the world. But by the time they reach elementary school the curiosity is gone. They do not care about the things they are supposed to learn. *Why?* What kills the curiosity of the child? As Jean Piaget, Bärbel Inhelder, and others have documented, Children begin to think as early as six months of age. At this age they are already developing notions of reality, causality, and morality. How can one disable this process—and how can one prevent its being disabled? Even better, how can one *encourage* this in the child? These are the questions that must be asked—and answered—in order to insure the long term success of the educational system. The answers are already known!

(to be continued...)

Mailing Comments for APATECH 47:

DAVE L: *Watchmen* is good literature as well as a fine comic book. I find few comic books that are also "literature," but this is one of them. □ Is your Powell's bookstore related to the Powell's in Chicago? □ **KATE:** how can we persuade you to join? Have you read (and if so, will you tell me about) any of Madeline L'Engle's nonfiction? I read some of her fiction when I was younger, and am curious about her other work.

ANDY: Congratulations on your upcoming wedding (tho' it may be over by the time you read this!). □ I am definitely not ambidextrous and *still* have problems discerning left from right. □ I was going to say "have trouble" but the logician/grammarian in me cried out "*being in* trouble is the state of *having* problems!"

SUSANNAH & DAVE: Perhaps Albert is simply bored in English class. I have never taken an interesting English class. Most persons in the field do not seem to know enough

philosophy, history, logic, & to carry on an interesting conversation, engage in intelligent discussion, or debate an issue; or, at the very least, do not *do* so. In my college English class I read the *Economist* every morning in class as I was bored with the endless review of grammar and trivial, unimportant works of "literature." □ Re American cuisine: We [I work at a Waldenbooks] received a cookbook just before Thanksgiving that has since been through nine printings. It's called *White Trash Cooking*, and is a compendium of American recipes such as "cooter pie." If I ever break down and buy a copy, I will frank some recipes.... This is one candidate for an American cuisine. The other is, according to Calvin Trillin (*American Fried: Adventures of a Happy Eater, Alice, Let's Eat, & Third Helpings*) and Jane & Michael Stern (*Square Meals, Roadfood and Goodfood, & Real American Food*), the regional specialties such as Valli's "loose hamburger." The authors are big champions of ribs in Omaha and fried chicken in Kansas City. Although I don't often eat such food, I feel Trillin & the Sterns are doing good work. Someday the only restaurants may be chains, and we will be able to read about the regional specialties with nostalgia.

ROLF: Re yct Barry: For every person "who cares" about the answer to a trivia question, there are at least two who ask "who cares?" I love the yuppie (Baby Boomer) edition of *Trivial Pursuit*, but the other players hate it!

AL: Remember the principle of defensive driving: you must drive so as to defend yourself from all the maniacs who are trying to get you!

GREG: You might enjoy *Where the River Runs Black*. It is a film about a boy who lives on the Rio Negro in Brazil[?]. He is the son of a young Catholic priest and a native woman. The priest travels upriver, is seduced, and disappears on the return trip. The boy grows up along the river. Circumstances conspire to bring him to civilization....A good film, extremely well photographed. □ I have an article on space entrepreneurship, which I shall frank here someday.

GUY W: How about energy weapons? Must we peace-bond photons?

SAM: I admire your ability to write an apazine at Ishercon. Your comments on documentation apply equally to software.

VALLI: You implied that there is more to your "travelogue" series than was printed here. If this is so, I would very much like to obtain copies of the rest! In the same vein, if you're in Cincinnati and have an afternoon, you might want to visit Mt. Adams, a small area near the art museum. I went there in search of a sandwich shop called **PIA'S** that was recommended. Pia's has **great** minestrone, thick enough to make a meal. The roast beef was as good as any I've ever had. It is hard for me to say that it's worth driving a hundred miles for a bowl of soup (although 200 miles is not too far for good pizza or Chinese) but it **is** worth driving a hundred miles for a bowl of Pia's minestrone! Among the eclectic mix of small shops, I found the **Shepard Bookstore**, a real bookshop, with not a best-seller in sight. The sales-clerk said that the chain bookstore had indeed put books in front of everyone's eyes, but "they have destroyed the literacy of books." □ I am familiar with Louis Henry Sullivan's Russian Orthodox church from the outside. Is it as nice on the inside?

JOA: Is it possible to set up a hydroponic herb garden? Fresh basil, chives, oregano, &c would be very nice in the wintertime—pesto all year 'round.

Mailing Comments for APATECH 48:

JAMIE: First, a system that "works," for the purposes of this discussion, can knock out **all** incoming missiles, both ICBMs & cruise missiles. Sorry I didn't define this better in the first place. Everyone agrees this is impossible. But *if it were*...if we could flip a switch and erect what amounted to an impenetrable shield" as you put it so well—then what? Ask the people who seem so pathologically afraid of nuclear missiles. They say, don't deploy. They seem to think the Soviets would never use nuclear weapons, so we do not need a defense against the Soviets. Missiles in silos are not a threat only if their owners are not inclined to use them. The above described people do not seem to think that any Soviet leaders will ever be inclined to use the missiles. History shows otherwise. Stalin starved perhaps as many as fifty million people as part of his program to collectivize agriculture. The Soviet army crushed in turn Latvia, Lithuania, Estonia, Hungary, Czechoslovakia, and Afghanistan. When we invaded Korea and Vietnam, we left when public opinion forced us to. The Soviets have never left a country they occupied until it was

pacified, and obeyed their wishes without the threat of force (remember the Brezhnev doctrine?). Some feel the Soviets would never use nuclear weapons. But look at Argentina. When the economy fell apart, the generals invaded the Falklands to gain popular support for their government. What will happen when the Soviet economy falls apart, sometime in the next century? Japan's economy is now the second largest in the world, and their per capita income is set to exceed ours early in the next decade. How will the Soviets feel when they are surpassed by, say, South Korea? If another Stalin should arise, and decide to press the button, what do we do? The Soviets have hardened their subway systems to serve as fallout shelters. They seem to think they can survive a nuclear war, losing only 5% of their population and rebuilding within two to five years. Can we trust them not to launch their missiles? And just *whose* missiles are they so afraid of? Are these disarmament types afraid of a Soviet first strike or of an American first strike?

GUY C.: New York is always paralyzed by snow. The people who live on the East Coast are such wimps when it comes to snow. They have at least one serious snowfall each year, but they never invest in snowplows or learn to deal with their anxiety....In the midwest a foot of snow doesn't slow things down appreciably, and we certainly don't go home from work early!

BONNIE: Greg Bear is planning a sequel to *Eon*, called *Eternity*...

BARRY: Are you still interested in acquiring a copy of the Kiri Te Kanawa recording of Strauss' "Four Last Songs"? If you are, I will look for it in outout catalogs & used record shops.

JOHN: The challenger tribute does speak for itself...

DONNA: Houghton is 15 hours from me—sorry!

ROD: Why do "Most people believe that no viewpoint other than their own can exist"? This is an important question! I Agree with you, by the way.

ROLF: If you discuss financing with a dealer, he may drop his price if he thinks that you will be paying interest charges. Then you pay cash, and get a deal!

SUSANNAH & DAVE: How *did* the myth that mummies never get sick arise?

STEVE: Re YCT Susannah: When my parents speak their native tongue (which I could speak when I was young) I can still understand it. However, I couldn't create a sentence it to save my life!

BOB & CONNIE: Rachel is a wonderful kid. I am sorry to hear of the miscarriage. I hope that all three of you are okay.

GUY W: As long as there is an outhouse, it's good enough for me.

JOA: "...once bomb threats become more real in the states..." Americans will continue to live in cavalier disregard of the facts of reality. Witness the recent poll on AIDS: more than 80% of the respondents feel that aids will become an epidemic, but less than 30% are changing their sexual habits. The average American *knows* "It will never happen to me," and no amount of persuasion will convince him otherwise. Sad but true. □ I stay up late to do things.

VALLI: In answer to your questions, I am a math/physics major @ Butler University. □ Re yct me re my ct Guy C re his ct Linda re bright people [I loved writing that!]: I do not know if a lack of self-esteem caused my friend to live in his car or if a lack of *motivation* caused it. I suspect it was the latter. □ It is clear that Italy is a better place to live than Britain!

That's all for now: I have an article to frank on space entrepreneurs, from *Reason* magazine, in the next issue. 'Till then, Enjoy! — *KIRAN*

SORRY ABOUT THE
BAD COPYING!
IT WAS FREE!!
WHEN I READ
THESE STRIPS
I FORGAVE GARY
TRUDEAU A LOT
OF HIS PAST
SINS....



I DO KNOW THAT IF GOD CALLS ORAL HOME, THERE WILL BE MILLIONS OF PEOPLE KICKING THEMSELVES FOR NOT HEEDING HIS WARNING.

WE CAN'T STAND IDLY BY, MIKEY. THE EYES OF THE WORLD ARE NOW ON OKLAHOMA!



HI! IT'S DAY 32 ON THE ORAL ROBERTS DEATH WATCH! GO TO TULSA!



FOR AN UP-DATE ON GOD'S DEMANDS, LET'S GO TO TULSA!



WELCOME BACK TO DAY 32 OF THE ORAL ROBERTS DEATH WATCH! MY PRODUCER JAKE AND I ARE STILL TALKING ABOUT GOD'S EXTRAORDINARY \$4.5 MILLION SHAKEDOWN.



JAKE, I THINK WHAT CONCERNS ME MOST IS THE CLAIM THAT GOD IS HOLDING A LIFE HOSTAGE FOR FUND-RAISING PURPOSES, THAT HE IS, IN EFFECT, A COMMUNIST TERRORIST.



AS ONE OBSERVER HAS PUT IT, "NO CAUSE CAN JUSTIFY TERRORISM. IT SAID IS THE CRIME OF COURAGE THAT IS INTOLERABLE!"



STRONG STUFF, BUT WOULDN'T GOD KNOW HE DOESN'T MEAN IT?



GO AHEAD, YOU'RE ON THE AIR!



WE'RE MINUTES LEFT IN BACK, DAY 32 OF THE ORAL ROBERTS DEATH WATCH! HOLDING CALLS...



ORAL ROBERTS AGREE, HE SHOULDNT HAVE IN TO GOD'S ULTIMATUMS.



OTHERWISE, WHERE'S IT GONNA STOP? IF WE PAY \$4.5 MILLION TO SAVE ROBERTS, NEXT THING YOU KNOW, WE'LL BE CONSIDERING \$5 MILLION FOR WOODY ALLEN, OR \$10 MILLION FOR JERRY GARZIA.



IT COULD JUST GET OUT OF HAND, YOU KNOW? I MEAN, HOW MUCH DO YOU SUPPOSE GOD COULD GET FOR SOMEONE LIKE VANNA WHITE?



AS IN, "HE'S GOT THE WHOLE WORLD IN HIS HANDS"?



HI, THIS IS RICHARD ROBERTS AND MY GUEST TODAY IS DAD, HI, DAD.



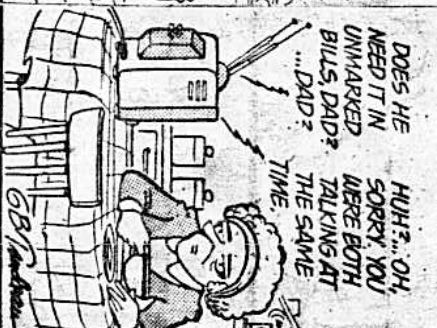
DAD, FIRST, LET'S ASSURE THE PEOPLE THAT YOUR ULTIMATUM IS ON THE UP-AND-UP. YOU'RE IN GOOD HEALTH, RIGHT?



GOD HAS SIMPLY RUN OUT OF PATIENCE. THAT'S WHY HE HAS DECIDED TO STRIKE ME DOWN IF WE DO NOT RECEIVE \$4.5 MILLION IN DONATIONS BY MARCH!



DOES HE NEED IT IN UNMARKED BILLS, DAD? ...DAD? THE SAME TIME.



2-6

2-5

2-4

2-3

2-2

2-1

ENTROPY AS A LIBERAL ART

SAM PARIS

PO BOX 41067

CHICAGO, IL 41067

Mailing comments! Get your fresh, hot mailing comments here!

I expect this 'zine to be mostly mailing comments. I generally put these off for last, then find I have no time for them. Let's see if this system works any better.

Jamie Hanrahan: Thank you for the good wishes. Though your own breakup sounds less fraught than mine, (on paper anyway) I think I detect a little more pain than you're willing to admit to. Please remember your own good advice.

I'm dismayed but not surprised by DEC's piggish behavior. Too many other companies (not just computer makers either) have the same nicklebiting attitude. I suspect that these tactics are, in the long run, self defeating. I have two examples in mind.

First is the TI-94 personal computer. Obviously designed from the ground up to give TI a monopoly on software and peripherals, this box scared buyers away in droves, despite an ad campaign featuring Bill Cosby.

Second is the the recent Lone Ranger movie (I forget the exact title). The backers took Clayton Moore to court to force him to stop making appearances as the Lone Ranger. The terrible publicity resulting from this seems to have sunk the film without a trace.

Your own disillusionment points out another good reason for not going this route. Why make your employees sorry they work for you?

Guy Consolmagno: Why not use some sort of photocell arrangement to time the occultation?

Donna... In regards your comment me (it took me so long to figure out what "in re yr ct me " meant that I thought I'd spell it out once): OK, you caught me. I was too lazy and too anxious to get back to all the neat **stuff** going on to ask for backissues. May I be forgiven?

In re Ishercon: Let me thank you again for your hospitality. Ishercon is a wonderful way to spend New Years, and I am grateful to you and Tullio (and the folks across the street) for making it possible.

As regards Microtechies: I thought Rachel and Marlene were charming! I was impressed by how well they handled the crowd. Surely if the kids can handle us, we can handle them.

Don't be too hard on Dave. Only a paragraph or so of my 'zine got Crumbcrunched (TM). Besides, as an oldest child and hence, experienced (if somewhat unwilling), babysitter, I can sympathise. An active, creative

child (the best kind) can cause trouble to propagate faster than the speed of light.

Childproofing is an especially useful technology. A rugrat-resistant Ishercon would be a challenge worthy of our steel. Perhaps we can make an amendment to Joa's list of projects.

Bonnie Jones: Hi Bonnie!

Barry Gehm: The "Shoe" cartoon is now hanging near my desk. I'm glad you could stop by on your way back from California. Next time bring your racquetball equipment..

John Hall: Welcome to the apa. Your title is great, but I think starting your car on fire is a pretty desperate way to get a 'zine topic. Thank you for including the Challenger tribute.

Joa: I'm sorry, but I can't agree with you about bomb defusing. The concept may seem a bit bloody, but is actually less violent than, say, pro football, another popular Ishercon pastime. Sort of a techie version of a rollercoaster, the game combines safe "danger" with intellectual stimulation. Try it next year, you may like it.

Please continue your DX reviews. They may yet stimulate me to get back into the game, or even to get my amateur license.

It was while listening to foreign broadcast stations that I most regreted being monolingual. It always seemed that the most exciting things were on the stations I couldn't understand.

Valli, In re yr ct Guy: I guess you're right. Though I washed a few dishes I didn't participate in many other domestic chores, and it is my vague impression that that was true of most of the other men at the con... er, party. (Though I did see some men on cleanup Sunday morning, attaboy guys.)

Rolf: Good luck with buying a car. I once spent a few afternoons "window shopping" at new car dealers. Pretending to be a potential buyer (All you have to do is ask a few questions) will get you all kinds of "once in a lifetime, today only" deals. Trying this at a few places where you have no intention of buying a car might be good basic training for the real thing.

In re yr ct Guy Wicker: I think a bomb designed by a non electronics expert might be tougher for us than you think. It would be unknown territory.

Crumbcrunchers: Water coming through your bathroom floor could damage a lot more than your computer. New floors and ceilings can run to quite a bit. Have you tried caulking the edges where the floor meets the walls?

What exactly is an Elderhostel?

Israel's radio buffs listening for scoops

Writing from Tel Aviv

It pays to listen to the radio in the Middle East, especially these days.

With a U.S. naval flotilla cruising ominously in the Eastern Mediterranean off the trouble-packed shores of Lebanon, American citizens and other nationals being held hostage in or near Beirut and the whereabouts of their would-be savior, Briton Terry Waite, a mystery, every tidbit of information is worth its weight in gold.

And the professional listeners are ready to sell around the clock.

The most famous of them is Mickey Gurdus, scion of a great journalistic family whose late father, Nathan Gurdus, served as the London Daily Express' correspondent in Poland until two of his British colleagues helped him escape to Palestine by way of Romania just as the Nazis were entering Warsaw. He headed the Agence

France-Presse bureau in Tel Aviv.

Mickey turned a boyhood hobby as a radio ham into a unique profession, thanks to his electronic talents and linguistic skills. He picks up the most obscure Arabic-speaking stations, tapes their news



Jay Bushinsky

broadcasts and alerts his clients, including Israel's own radio and TV network as well as ABC and other international media, of their contents.

Mickey's "scoops" are as countless as they are incredible. Some of them got him into trouble with the Israeli authorities, notably his monitoring of inflight radio exchanges between the pilots of hijacked airliners or of anti-terrorist task forces on rescue operations.

The stations that Mickey and his local competitors find on their super-sensitive dials often turn out to be gold mines of desperately sought information.

Take the obscure "Voice of the Mountain" that broadcasts from central Lebanon in the name of the militant Druze militia headed by Walid Jumblatt, the onetime playboy and current politician who also leads Lebanon's Progressive Socialist Party.

Two weeks ago, another Israeli radio monitor heard the "Voice of the Mountain" say that Terry Waite, who had come to Lebanon as the Archbishop of Canterbury's envoy in a bid to extricate hostages, had become a hostage himself.

She contacted veteran foreign correspondent Ted Levite, who in turn broke the story worldwide in a live interview on London's popular "TV A.M." It took the archbishop and the rest of the British establishment nearly 10 days to admit that Waite was in captivity.

Israeli ears are also trained on the entire spectrum of Arabic-speaking radio stations throughout the Arab world as well as on the Persian broadcasters of Iran, the Turkish stations of mainland Turkey and the Turkish-controlled sector of Cyprus.

They compete with the full-time monitors based in Nicosia, Cyprus' capital, who feed the international news agencies with up-to-date reports from the front lines of the Persian Gulf War.

All this electronic-journalistic activity may be due to the information explosion wrought by the advent of the transistor and the consequent ability of the Middle East's far-flung inhabitants to make up for their lack of newspapers while moving across its deserts or their inability to read printed words by merely turning on their radios.

The monitors hear every word beamed at them and are quick to make sure the rest of the world gets the message too. As they say, there are all kinds of ways to make a living, and listening to the radio is one of them.

Jay Bushinsky runs the Chicago Sun-Times' Middle East Bureau.

I WONDER IF SOMEONE
IN LEBANON WILL PAY ME FOR
LISTENING TO NPR...?

Steve: I wish I could have been awake for your dance at Capricon, a number of people have raved about how good the music was. Maybe next year?

Rugrats: I'm sorry to hear about Connie.

Guy Wicker: "Extraordinary Popular Delusions and the Madness of Crowds" is an extraordinary book. You should give it a higher recommendation. Where else can you learn about the Great Tulip Mania, Or about the time poisoning became a popular fad? I think that if Charles Mackay were alive and writing today, we would see some juicy stuff about Cabbage Patch dolls or \$900/oz. gold.

Bernard Baruch, the financier, claimed that this book saved him millions of dollars.

Rod: 150 kps is pretty fast. I think I was one of the people who objected to .03C, but I don't recall any details. Why not refresh my memory? I am profoundly ignorant about what has actually been observed, but it seems possible that extra solar matter might travel that fast.

You mentioned the TAU probe. I just came across an article about it that I'll include in this apa.

In re yr ct me: I said uniform gravitational field. In theory, you might get such a field from an infinite plane of matter. In practice, this means your experiment takes place in a volume small enough that the variations of intensity and direction you get from a radial field are negligible. Like in a car.

There. Ive done it, an all comments apa. As expected, there's no time left for anything else. See y'all later.

Ambitious TAU project would send a spacecraft into deep space to obtain data on stars and galaxies

A TEAM OF researchers at NASA's Jet Propulsion Laboratory, Pasadena, CA, is working on a spacecraft designed for interstellar travel.

The TAU (thousand astronomical units) Project to achieve this deep space exploration will rely on a number of emerging technologies, according to Dr. Lew Allen of JPL, who conceived the mission. Allen asked Aden and Marjorie Meinel (a husband and wife astronomer team) to organize studies of possible TAU systems. Although work on TAU is being carried out by JPL researchers, the program is not yet a NASA project.

Primary goal of the project is to obtain more-accurate data on the distances of stars and galaxies, as well as measure properties of interstellar space. The voyage itself could take 50 to 100 yr to complete and the spacecraft would travel some 100 billion mi (1×10^{11} mi).

Keys to the success of the mission include the use of an ion propulsion system, a 1-MW nuclear reactor, and an optical laser communications system. To attain the high speeds to make this type of mission practical, preliminary designs have relied on the use of an ion propulsion system.

An ion engine typically puts out a small amount of thrust at a constant rate, which in the vacuum of space would steadily increase acceleration until very

high velocities are achieved. Aden Meinel said that these engines can achieve a velocity 40 times greater than that attained with the chemical propulsion system used to launch the space shuttle.

He reported that JPL researchers have performed ground tests on a small ion engine that they want to use in a proof-of-concept lunar mission in the

next two years.

Marjorie Meinel told R&D, "Present plans call for using 10 ion engines (fueled with solid xenon propellant) fired in pairs for 2 yr/pair. This would give us a total firing time of about 10 years, after which the spacecraft would be well beyond the outermost planet."

A 1-MW nuclear reactor would provide energy to electronically accelerate a

Telescope's greatest asset is viewing time

ASTRONOMERS have started to use a new 94-in. telescope that can capture the faintest glimmers of light at the edge of the observable universe. The telescope is located atop Arizona's Kitt Peak.

The \$2 million instrument, owned jointly by Dartmouth College, Massachusetts Institute of Technology, and Univ. of Michigan, will take some of the pressure off national telescope facilities.

"The national telescopes are hard to get time on; they're highly competitive," said Todd Boroson, director of the McGraw-Hill Observatory, the consortium that operates the telescope.

"You have to schedule time far in advance, and usually very conservative proposals are the ones that get approved. Discoveries are more likely to be made on

our new telescope because you can look at things [managers of the] national telescopes would not allow," Boroson added.

The new telescope uses a primary mirror to capture light from objects under study and then reflects that light to a smaller mirror located above it. Light from the small mirror bounces back to the center of the primary mirror and into a 1-cm² charge-coupled device that contains roughly 1 million tiny light detectors. Data from the CCD are fed directly to a computer.

Initial studies using the telescope, Boroson said, will concentrate on the nature and classification of quasars, and the shapes and distribution of galaxies. □

THIS PARAGRAPH
BOTHERS ME
A LOT.

94 RESEARCH & DEVELOPMENT—FEBRUARY 1987

beam of ions through the engine to produce thrust. After the nuclear fuel has been consumed (estimated to happen 6 billion mi from Earth), the reactor and propulsion system would be jettisoned.

The spacecraft would keep moving at the same end-point velocity of 225,000 mph, but as a free flyer slowly rotating about the optical axis of a 1-m communications telescope. Power for the experiments and the communications system would come from a radioisotope generator.

The spacecraft, including the ion propulsion system, would weigh about 50,000 lb (22,700 kg) on launch from a rocket booster or from the shuttle. The TAU science vehicle itself would weigh 11,000 lb (5,000 kg).

The laser communications system will allow higher bit rates to be achieved, which are necessary to send back data from such extreme distances. The data transmission rate is projected to be 20 kbits/sec. At a distance of 1,000 AU (1 AU = ~93 million mi), one-way data transmission time would be about a week.

The plan is to start taking astronomical data with a 1.5-m astrometric telescope while the spacecraft is traveling past the planets. About 10 yr after launch, the craft could begin taking measurements of stars as far away as the center of the Milky Way galaxy.

Primary goal of the mission is to do

precision astronomy from a very long trigonometric-baseline, compared to a long time-baseline which is being used in a star survey by astronomers at Mt. Palomar observatory that spans 30 yr. The ultimate objective is to use a baseline of 1,000 AU but, long before reaching that distance, the TAU experiments will take measurements over much longer baselines than ever before possible.

Currently, JPL states, accurate measurements are limited to about 400 light-years with observations from points at opposite sides of Earth. The TAU system

would provide a significant improvement over that.

Besides star locations, data will be collected on the solar magnetic field, interstellar plasma, and Oort clouds—which are thought to be a region of primitive objects left over from the formation of the solar system. Some of these objects, astronomers believe, may be propelled from the clouds to become comets orbiting the Sun.

Aden Meinel said, "There's no observed evidence of the clouds at present. The TAU mission would obtain some information about those clouds from certain instruments but it would not 'see' them, because the photocometry material has no light of its own and it's so far from the Sun that it is not lit by it," he explained.

Other measurements TAU could obtain that otherwise would be impossible, he said, include long-wavelength radio waves and very-low-energy cosmic waves.

"We have no way of measuring those phenomena until we get beyond the heliosphere and into a region where the magnetic field of our Sun ceases to have any influence. Within the heliosphere, the field acts as a shield, preventing those things from making it to the vicinity of Earth."

Two spacecraft, *Voyager 1* and 2, now are heading for interstellar space, but at a comparatively slow speed. "At

their speeds [about 36,000 mph], it will take them 20,000 years to travel only one light-year," Aden Meinel said.

"TAU will take about a tenth of that time to travel one light-year. To do better than that would require going to a new propulsion system, such as one based on contained fusion."

The Voyager experience, he said, is encouraging for TAU in terms of duration. "It looks as though their power supplies should keep running until 2015."

This is encouraging, he added, "since they're using technology from around 1960 and TAU will be much more advanced. If we develop a long-duration thermal isotope power system with a nominal life of 50 years, it could well last for 100 to 200 years," he added. □



"By using a production model in a realistic field test we eliminate prototype computer-simulated stress evaluations completely."



"We're out of paper towels in the restroom."

EASTO

guy consolmagno

200 high st, easton pa 18042

This I plan to make a pretty long submission, but much of what I have this month will be copied from other sources—I won't have to write so much.

It's been a pretty busy month. Classes and so forth have kept me busy, especially the astronomy class. I'm running an observing lab, and so I get to go outside and see neat things through our telescopes; but this also means that I have to prepare finder sheets. I'm lifting them from Dan and my "Turn Left at Orion" book, which is slowly getting written.

A sample "finder sheet" for a fairly obscure object is enclosed. The pictures are not final, obviously—I've swiped sky charts from H. A. Rey's The Stars, a book I heartily recommend to anyone.

For those of you who'd asked, the book is designed to be used with a 2" to 3" telescope, but in fact it turns out to be useful even with a 6". The difference is that objects we list as very hard to find in the 3" are actually quite easy in the 6"s.

McGraw Hill is nibbling at my planetary sciences textbook, the one I'm using this term, but they'll probably pass. They point out (as have most of the other publishers who've seen it) that the market for planetary science texts is small, while the market for astronomy texts is much bigger—so, gee, why don't I write an astronomy textbook? Aside from the fact that I don't know enough astronomy to do a decent job of it (earlier this afternoon somebody asked me what exactly a nova was, and I had to look it up in Abell), there are ten million astronomy textbooks out there already, probably written by people who had publishers dangling money in front of them to write the books the publishers think will sell... because those are the books that do sell, because those are the only books out there. I teach planets; I want a book that covers planets; and tough, if nobody wants to publish it I'll continue to publish it myself.

The high school discussion on the Future of NASA went pretty well, I guess. We had a big turnout, about 50 people, so there were too many folks with too many different backgrounds and levels of knowledge for a discussion to really build up, but still there were lots of pertinent comments and questions. They say the kids really are interested, and optimistic, about space. But they have no understanding of what it'll take. The SF movies have made it all look

In a sense that might be a good thing; we are raising a generation who are not afraid of travelling in space, and indeed expect it as a matter of course. Maybe the less exotic it seems, the more support it'll get.

For most of the talk, however, I felt like I was just paraphrasing things I've heard Greg say in the past, only not so well. The materials I got from fellow apateachers, including the comments you wrote in response to my plea for help, were very useful—they made up probably half of what I had to say. Thanks again.

McKelvy is having "Sub-cultures" as our theme this term. The first week we showed Real Genius, and read passages from biographies of Einstein and Bertrand Russell, to discuss the subculture of genius... or "why do I feel like a geek in the grocery store?" The student who was fascinated by Russell's life is Najib El Boudhakani, from Morocco; for a long time I had trouble understand who this "Ber-TRAH Rousseau" character was, until I realized that he'd only read his stuff in French back home...

Last weekend we went out to Lancaster... one of our students, from Turkey, has parents who are friends with a couple who teach at the Lancaster Theological Seminary, right near Franklin and Marshall College; these friends are good friends of a fellow who is a tobacco buyer among the Amish in the area. So through that connect we got to go out to visit an Amish farm, talk with the farmer about his farming, his crops, his equipment, and so forth. We could also ask talk about the Amish with the tobacco buyer and the couple from the Seminary.

I'm still sort of blown away by it all. The Amish lifestyle is one that is very appealing in so many ways, with their sense of family, and of community, and belonging; their closeness to God, and to the land; and the great relief of not having to take responsibility for a lot of decisions in life, by leaving such to the pastors and the bishops. (As my mom said, "us Catholics used to be like that once!")

That last point is, of course, the crux of the biggest problem with the lifestyle—which is why us Catholics aren't like that anymore. It's too easy to cut yourself off from the rest of the world, feeling different and superior, and it's too easy to cut the rest of the world off from you as well.

And there aren't many Amish astronomers.

That last point isn't as flip as it sounds... since they do not emphasize education, they cut themselves off from the depth of the mystery and grandeur of the universe, and its creator.

I've actually started doing Science on my Mac! Using a spreadsheet program, Excel, I've programmed up a little routine to work out how much an icy moon should expand and contract as it warms up, melts inside, then freezes again. The abstract below is a result of the work this month:

Models for Uranian Moon Expansion: Why Isn't Oberon Cracked?

GUY CONSOLMAGNO (Physics Department, Lafayette College, Easton PA 18042) (Sponsor: D. M. Davis)

A mathematical model (Consolmagno, *Icarus* 64, 401, 1985) predicts quantitatively the amount of stress in the crust of an icy moon due to its melting and refreezing, given the moon's radius and density.

Using the radii and densities found by Voyager, we predict that the stress on Ariel due to the melting and refreezing of ammonia-water solution will be similar to the stress in Saturn's moon Rhea, over 50 bars, while on Umbriel (a moon of similar size to Ariel but lower in density) the stress should be much less than on Ariel. It is thus possible that melting and refreezing in this moon was limited enough to prevent visible cracks from forming. In fact, Ariel has numerous graben while the surface of Umbriel appears to be dark, primitive, and uncracked. However, Umbriel itself is similar in size and density to Saturn's moon Dione, which is extensively evolved. The differences in their surfaces may be due to some systematic difference between the moons of Saturn and those of Uranus, e.g. the much lower ambient temperature at Uranus.

Titania and Oberon are another pair of similar size but slightly varying densities, and again the denser moon (Titania) shows evidence of cracking and resurfacing while Oberon does not. However, the density difference between these moons seems much too small to account for such a big difference in internal evolution. The predicted stresses in Oberon are larger than those predicted for any other moon, save Titania. Why isn't Oberon cracked?

One possibility is that these moons are just big enough to have extensive internal convection of ice, thus limiting the amount of melting inside them. Alternatively, a moon formed with an ice mantle overlying a rocky core will not melt as much as a homogeneously assembled moon.

Miranda is, by all accounts, a puzzle. It is too small for endogenic long lived radionuclides to be responsible for the evolved surface seen on this moon.

and now... Mailing Comments...

Bonnie Jones: At 27, you are 7 seven years younger than me. I can remember when I was dating someone 7 years younger, and felt horrified because she was such a child. Hmm... well, when I was your age... I was just finished being a grad student. I had my first real job, a place of my own, a car, and hopes of my first steady girlfriend (it didn't pan out... she was seven years younger than me, an undergraduate for heaven's sake!) I too wondered why all my friends seemed to be grown-ups when I certainly didn't feel like one. I now do have a full time job and a car, but I've given up wondering why I don't feel grown up. I just wonder why students seem so much more immature than I used to think they were, back when I were one. (And my closest friend is still an undergraduate, only now she's someone 12 years younger than me!)

Empty House: I envy you your Laser Writer!

I wish I could have made it to the New Year's (thanks for the invite) if only to finally meet some of you people in the flesh. As someone who probably never will make it out there, however, let me put in my vote in favor of children. Those who love them, love them, and those who don't, deserve them!

Cramcrunchers: We were lucky to get our Ready-SetGo 3's early—they've raised the prices, and no longer sell through discount mail order houses. On the other hand, they nicely sent me (without warning) a new disk of the updated version of the program to replace my original 3.0 version.

About arts versus science students... my astronomy class is aimed at arts students, but in fact 13 of the 28 students are engineering or science majors. My first test was a five-question essay take-home test. NO calculations. But the questions all demanded that one think about the material and derive some new idea from it, rather than just regurgitate what was in the book.

Sample: "Compare how scientists before 1800 studied meteorites with the attitude that scientists today have toward UFO's. How are UFO's different from meteorites? How are they similar? Is the current skepticism about UFO's among scientists today justified? What would it take to convince scientists that UFO's exist?"

The average score of the arts students was 73%; high score a 92. For the engineers, the average was 95%, low score an 85! How the hell do I grade this? The arts students just were not used to being asked to come up with new concepts...

The Pentagon crack down!

laser velocity, mass, and density, the last being decreased as the foil thickness increased. Optical diagnostic methods were concerned to use and provide good results. The foil was irradiated by a laser beam in the application to dense plasmas from acceleration, however, in electric arcs in that light does not penetrate into plasmas with a density $> 10^{21} \text{ cm}^{-3}$. Nevertheless, combining several optical methods and diagnosing different foil regions at the front and rear sides of the foil makes the problem solvable. Actually, three methods have been used: (1) the space-time diagram of the critical density surface grating the velocity time diagram of the foil was traced by means of a second harmonic spectrum; (2) the movement of the laser ionization surface corresponding to an optical shadow; (3) the foil's center of mass velocity was measured with a hollow ballistic pendulum absorbing considerable improvement in accuracy. Experiments were performed with two channels of the UMI-35 laser facility with a laser pulse width of 10 ns and a pulse duration of 6-8 ns. Thin foil with thicknesses of 0.1-0.5 μm and densities of 10-100 g/cm³ were accelerated to velocities of the order of 100 km/s. There have been accelerated foil velocity and thermal expansion on foil thickness is discussed. (Poster paper)

THL37 Theory of an induced irradiated adatom
SANDER VAN SMAALEN, THOMAS F. GEORGE, State University of New York, Buffalo, NY 14260

The dynamics of an adsorbed atom irradiated by an infrared laser in resonance with the vibrational levels of the adatom can be described by the reduced density matrix of the adatom. A numerical butte approach for the laser-adatom interaction is presented. Dissipation against the substrate degrees of freedom is described by a perturbation theory. Both pulsed lasers and cw lasers are considered. The induced probability of finding the adatom in the low-energy state and in the high-energy state appears that the time evolution of the occupation probability is coupled to those of the coherences, i.e., a master equation cannot be obtained. The time evolution of all the elements of the induced density matrix has to be taken into account. These expressions are used as a basis for the study of physical processes as resonant dephasing, desorption, and laser-induced thermal desorption. Resonant desorption is studied by the addition of loss terms into the equations of motion of the adatom. The induced loss terms into the equations of motion of the adatom are calculated. Expressions for the rate of desorption as well as the rate of energy transfer to the substrate are given. In particular, a comparison is made for the effect of a cw laser vs a pulsed laser on the desorption and its orienting. (Poster paper)

THL38 Wavelength dependence of laser-induced laser break-down thresholds

R. PRINICK, D. BENNETT, U.S. Army Atmospheric Sciences Laboratory, WSAIR, NIA 8002, PETER CHITLER, M. JAKUBISZ, New Mexico State U., Physics Department, Las Cruces, NM 88004

Measurements of laser-induced laser breakdown thresholds have been made for a number of different laser wavelengths using a pulsed Nd:YAG laser ($\lambda = 1.06, 0.53, 0.26, 0.21 \mu\text{m}$). The breakdown threshold decreases with decreasing wavelength. Thresholds are nearly independent of droplet refractive index at the near-IR wavelengths ($\lambda = 1.06 \mu\text{m}$), but show increasing sensitivity to refractive index at shorter visible and ultraviolet wavelengths. (Poster paper)

THL39 Optical bistable interaction of laser radiation with microparticles

K. M. LEUNG, Polytechnic Institute of New York, Physics Department, Brooklyn, NY 11201

Intrinsic optical bistability in the scattering and absorption of laser radiation from microstructures having an internal dielectric refractive index is investigated. We work only with particles whose radius is small compared with the wavelength of the incident radiation. Our calculation is based on the assumption that the scattering and absorption cross sections are small compared with the area of the particle. For particles with sharp surface parameters, optical bistability can occur in a variety of scattering curves above a certain critical value. The threshold intensity is found to

be reduced by several orders of magnitude compared with the non resonant case. Optical switching can also occur at threshold intensities above the threshold by sweeping the frequency across the resonant frequency. The bistable behavior is studied for a variety of different particle shapes, as well as associated with a very large differential gain. Surface cases, optical bistability can also be achieved, and there are, in addition, interesting shape dependence and orientational effects. (Poster paper)

1. K. M. Leung, *Phys. Rev. A* **33**, 246 (1986)

2. K. M. Leung and T. L. Liu, unpublished

THL40 Laser-induced surface chemical epitaxy: a novel thin film deposition technique
CHARLEND STINEGRAVE, A. FREEDMAN, Aerodyne Research, Inc., Carrier for Chemical Environmental Physics, 45 Manning Rd., Billerica, MA 01821

A new laser-induced epitaxial growth process is described, and key issues regarding the feasibility of the technique are discussed. Various conventional laser-induced processes which generally involve thermal and/or chemical processes are compared with the laser-induced surface chemical epitaxy process. The present technique involves a pulsed laser beam which induces a surface chemical reaction. The reaction products are deposited on the substrate, forming a thin film. The process is controlled by the laser pulse energy, pulse width, and pulse frequency. The technique is applicable to a wide range of materials and substrates. The process is simple, rapid, and scalable. The technique is being used to deposit thin films of various materials for microelectronic and optoelectronic applications. (Poster paper)

LASER PHOTO-CHEMISTRY AND PHOTOPHYSICS

THL41 Paper withdrawn

THL42 Near-resonant energy transfer theory applied to nonequilibrium processes: CO₂, N₂O, and their isotopic analogs
DOUGLAS E. GOUGH, KEVIN L. MCNESEY, RICHARD D. BATES, Jr., Georgetown U., Chemistry Department, Washington, DC 20057

An expression for near-resonant energy transfer cross sections has been derived for a nonequilibrium system, using the quantum rate theory. The expression is valid for a wide range of nonequilibrium over velocity and rotational state distributions. The formula is valid even when the energy defect becomes of the order of or larger than kT . The theory has been applied to energy transfer between two linear molecules, which occurs via long range near-resonant dipole-dipole interactions. The resulting transition moments of each molecule. The resulting transition moments of each molecule agree with experiment to within a factor of 2. The theory predicts an improvement of several orders of magnitude in the rate of energy transfer calculations based on the approximate solution to a semi-classical first Born approximation (first obtained by Van Kesteren, 1968), and extended by Sharma and Blau and Cross and Gordon,

This expression is applied to previous and new experimental results of energy flow in CO₂ and N₂O and their isotopic analogs, providing an effective probe of rate processes of importance to molecular infrared lasers. (Poster paper)

1. J. Van Kesteren, *Can. J. Phys.* **41**, 433 (1963)

2. J. G. Cross and R. G. Gordon, *J. Chem. Phys.* **46**, 3511 (1966); R. D. Sharma and C. A. Blau, *J. Chem. Phys.* **50**, 824 (1969)

THL43 Kinetic spectroscopy using a color center laser
J. W. STEPHENS, J. L. HALL, D. R. LANDER, R. F. CHILL, JR., J. V. KASPER, FRANK K. TITTEL, Rice U., P.O. Box 1892, Houston, TX 77251

Infrared kinetic spectroscopy is being developed using a pulsed excimer laser for ultraviolet photolysis and a color center laser as an infrared probe in the 2-3.0 μm region. Sub-microsecond time resolution is possible with the 1400 μm excimer laser pulses and the infrared probe is currently employed. Previous work on the Br₂, OH, and NH₃ radicals has led to the development of three monitoring schemes based on the use of either balanced detectors, magnetic rotation, or short-time monitoring. Kinetic studies of the photolysis of C_2H_4 and C_2H_2 are currently underway. A NO reaction has been monitored by measuring the branching ratio of the two products. The reaction is being monitored by measuring the production of acetylene as indicated in a $-1,1$ -stilbene for this radical, demonstrating the ability to detect short lived species. Other work includes the production of highly reactive OH atoms by the photolysis of O_2 , providing a method for generating free radicals from stable molecules by hydrogen atom abstraction. Additional studies on the spectroscopy and kinetics of other free radicals are in progress. (Poster paper)

THL44 Paper withdrawn

THL47 Paper withdrawn

THL48 Paper withdrawn

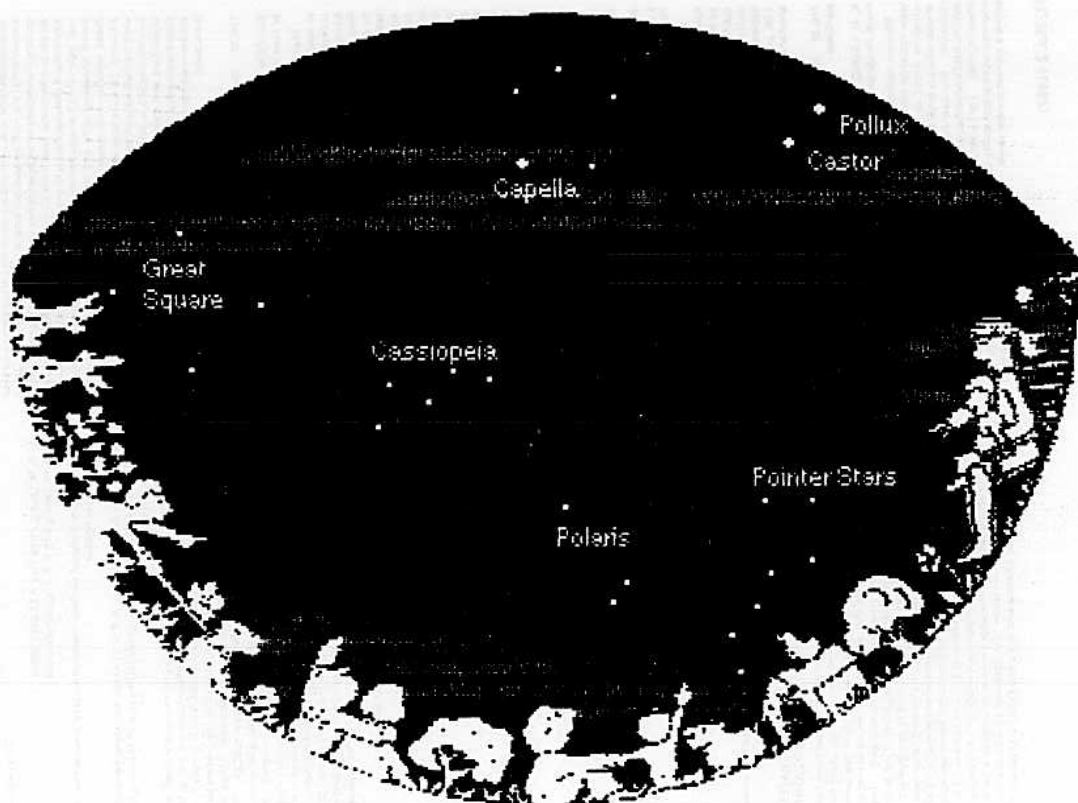
THL46 Paper withdrawn

THL45 Paper withdrawn

Ballotin of the
American Physical
Society,
Feb., 1987

Why I am opposed to
Star Wars...

Seasonal Objects: Winter



Looking North

Observing the Winter Sky

It's cold at night in the wintertime, even California or Florida. In the north, the darkest and clearest nights are also the coldest, when you are looking through crisp air from the Arctic. In addition, operating a telescope means standing still for a long period of time. That tends to make you even colder. And remember that you'll be adjusting knobs and levers on your telescope, which tend to be made of metal and get very cold indeed. Gloves, a hat, and several layers of underclothing are a necessity.

Besides dressing warmly, you should also take the time before you observe to clear a spot where you'll set up the telescope. Shovel the snow off the ground, put down a blanket perhaps, bring a chair or a stool to sit on. Do what you can to make yourself comfortable.

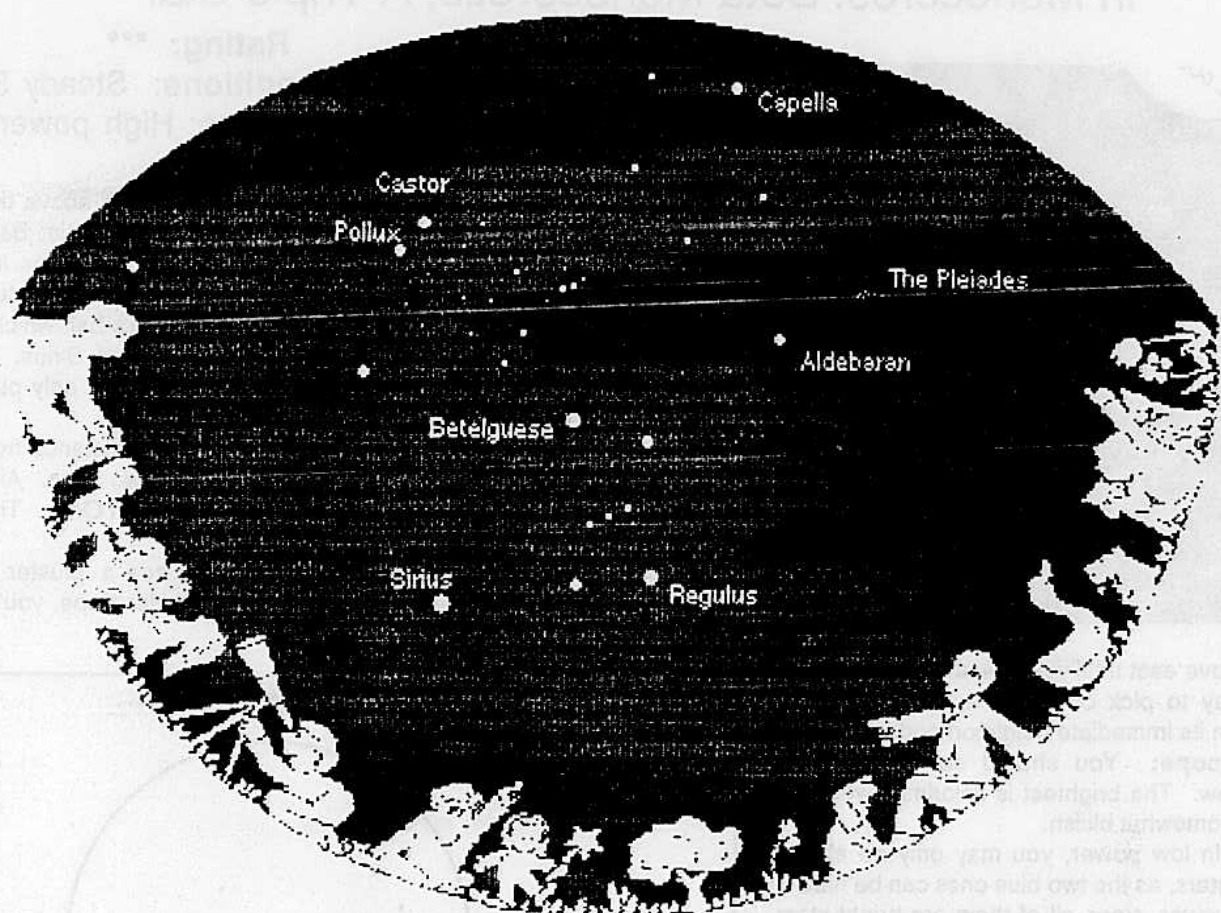
Set up your telescope outside about half an hour before you start to observe. This gives the lenses and mirrors time to cool down. If the telescope is hotter than the surrounding air, you may get convection currents that spoil the im-

age. If warm, moist indoor air is trapped inside your telescope, it may condense and fog over your lens (this is especially a problem on catoptric telescopes—see page ____) so before you put in your eyepieces, give the warm air time to escape from inside your telescope.

Finding Your Way: Winter Sky Guideposts

First turn to the south and find Orion: three bright stars make up his belt, two stars (including a bright red one to the left) are his shoulders, and two more (including a bright blue star to the right) make his legs. The bright red shoulder star is called "Betelgeuse" (pronounce it "beetle-juice" and you'll be close enough) while the bright blue star in his leg is named Regulus.

The three stars in Orion's belt point down and to the left to a very bright star, Sirius, rising in the southeast. This star is in fact the brightest star in the sky (not counting planets) and belongs to the constellation Canis Major, Latin for "big dog". Hence it's often called the "dog star".



Looking South

Above Orion and to the right is a bright star called Aldebaran, and just beyond it you'll see a cluster of little stars called the Pleiades. They're part of the constellation Taurus (The Bull). This constellation is a member of the zodiac, which are twelve constellations through which the moon and planets travel. If you see a bright star in a zodiac constellation that doesn't appear on the charts, it's probably a planet.

Above Taurus, north and east of Aldebaran, is a large lopsided pentagon of five stars. The brightest of these stars, the one to the north and east, is called Capella. These stars mark the location of the constellation Auriga.

East of Auriga, you'll find two bright stars close to each other. They're Castor and Pollux. Stretching out to the south and west from them are the stars of Gemini, the twins. With a little imagination you can "connect the dots" to make out the shape of two stick men, lying parallel to the horizon during this season. Gemini is also a zodiac constellation--be on the lookout for planets.

To the north and east, the Big Dipper is rising. Part of its handle may be obscured by objects on the horizon, depending on how far south you live. The two highest stars, at the end of the dipper's bowl, point to the north towards Polaris, the North Star. Face this star, and you'll always face due north.

Higher in the northern sky, and to the west, are five bright stars in the shape of a large W (or M, depending on your orientation). This is Cassiopeia.

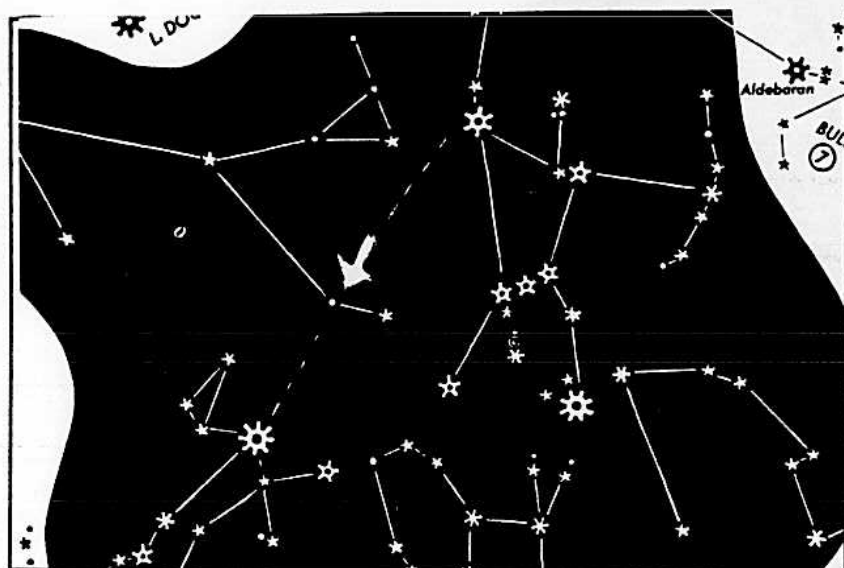
Setting almost due west, beyond Cassiopeia, are the four stars of the "Great Square". Actually, they seem to be oriented more like a diamond during this time of year.

In Monoceros: Beta Monocerotis, A Triple Star

Rating: ***

Sky Conditions: Steady Sky

Eyepiece: High power



Where to Look: Find Orion, high above the southern horizon, and find the bright red star, Betelgeuse, which makes his shoulder (up and to the left of the three stars in his belt). Then, from Orion, turn to the left and follow the stars in Orion's belt which point to the southeast at a very bright star, Sirius. (Sirius is in fact the brightest star in the sky; only planets get brighter.)

A little less than halfway of the distance from Sirius back to Betelgeuse you'll find two stars. Aim for the one to the east, the one away from Orion. That's Beta Monocerotis.

In the Finderscope: If you see a cluster of two or three stars together in the finderscope, you're too far

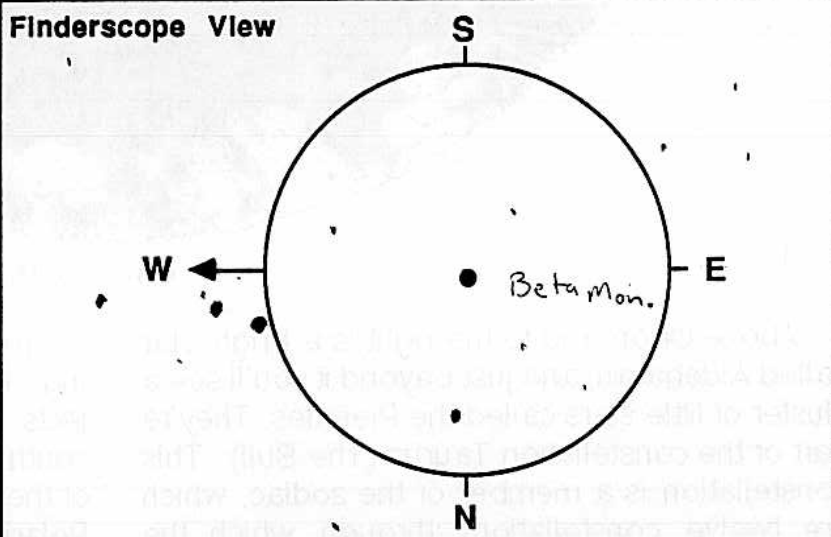
to the west--move east until you see another star, by itself, fairly easy to pick out. Beta Monocerotis is the brightest star in its immediate neighborhood.

In the Telescope: You should see three stars, roughly in a row. The brightest is colorless, while the other two are somewhat bluish.

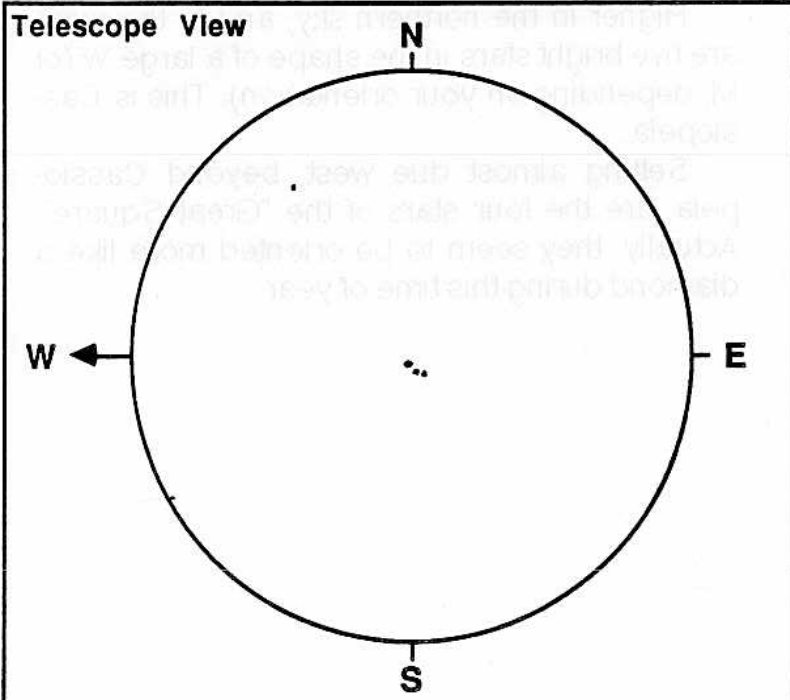
Comments: In low power, you may only be able to make out two stars, as the two blue ones can be hard to separate. However, since all of them are bright stars, this object can stand the highest magnification you've got, and you should be able to split them even on nights that are not all that steady.

What You're Looking At: Beta Monocerotis is actually a quadruple star. Three of the stars are reasonably bright and close to each other, while the fourth is dimmer (too dim to be seen by a small telescope) and farther away from the others. They lie about 450 light-years from us. (One well-known handbook lists the distance as 150 lightyears, but we suspect he meant 150

Finderscope View



Telescope View



parsecs, which would be about 470 lightyears, in agreement with other published measurements.) The white star, A, is about 400 AU from B and C, which are less than half that distance from each other. Given their great distances apart, they move very slowly about each other--too slowly for us to have noticed any change in their position over the past hundred years.

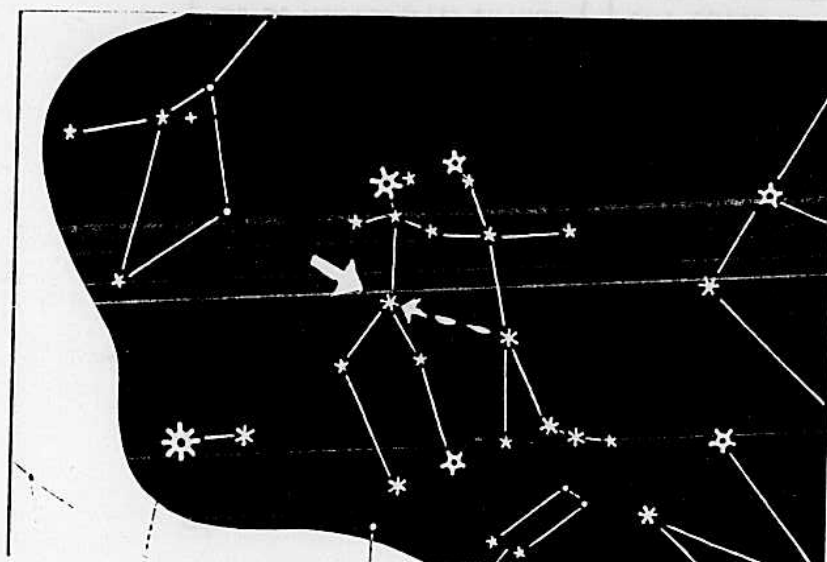
Star	Magnitude	Color	Location
A	4.6	White	Primary Star
B	5.2	Blue	7" SE from A
C	5.6	Blue	3" ESE from B

In Gemini: A Planetary Nebula, "The Clown Face" NGC 2392

Rating: *

Sky Conditions: Dark Skies

Eyeiece: Low, medium power



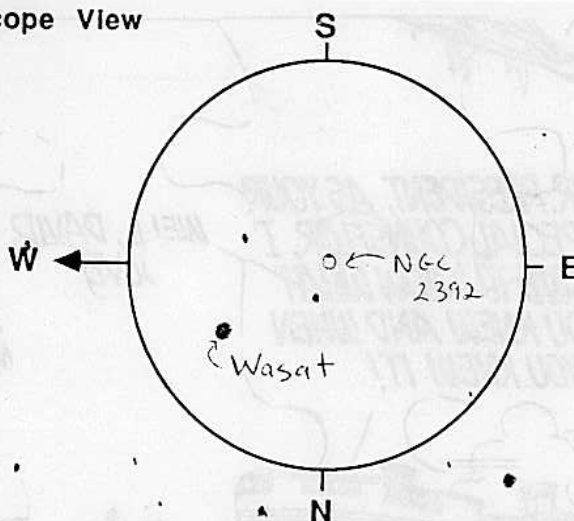
Where to Look: Find the Twins; Castor is the star to the west (on the right, facing south) and Pollux is the star to the east (left). These two bright stars are the head of two "stick-men". The star at the "waist" of the stickman on the left (the second star down from Pollux) is called Wasat; the third star down from Castor, at the waist of that stickman, is Mebusta. Draw a line from Mebusta, through Wasat, and continue one quarter of that distance further.

In the Finderscope: Aim first at Wasat. In the finderscope, this will be the brightest of three stars that make an equilateral triangle. Move to the side of this triangle away from Wasat. The nebula is up and just to the left (south and a bit east) of the right-hand (western) star in that part of the triangle.

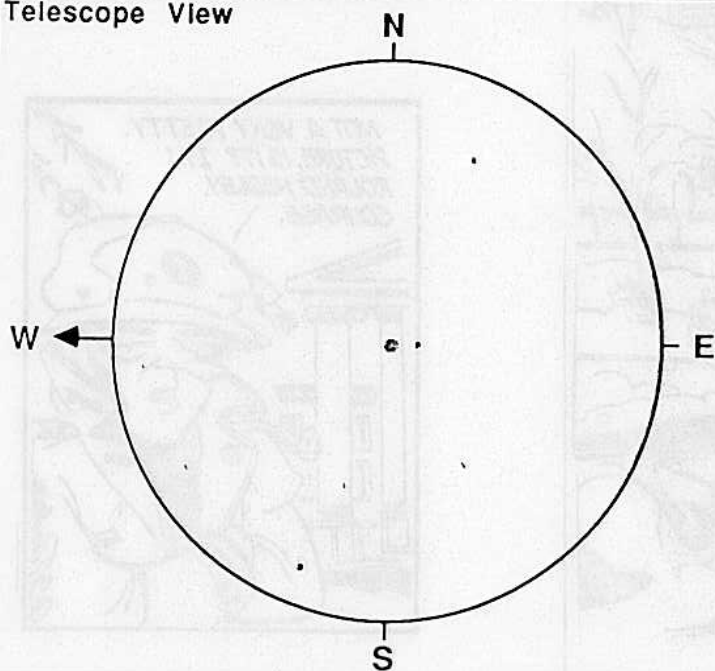
In the Telescope: This looks like a small, greenish, out of focus star, next to another star. At low power the two may look like a double star, but higher magnification shows it as a round and fuzzy disk.

Comments: This is quite a bright nebula, and can stand high magnification; indeed, on a sharp night you may be able to see the central star in this nebula. The greenish color is distinct, even in a small telescope. To see the dark features that give this nebula its name, the "Clown Face", you'd need a very large telescope. more) however.

Finderscope View



Telescope View



What You're Looking At: This particular planetary nebula is located roughly 3000 light years from us (different techniques estimate distances anywhere from 1400 to 3600 lightyears). The cloud of gas itself is more than half a lightyear across, and judging from the motions of the gas it appears to be growing at about 3 billion miles per year. Theorists estimate that this nebula may be less than 2,000 years old, making it one of the youngest of the planetary nebulae.



Blame It on the Supernova

W. Skeffington Higgins

February 27, 1987

The Twenty-Sixth Spinthairiscope Media production, for Apa-Tech 49. The author at 853 Lorlyn Drive, Apartment 1E, West Chicago, Illinois 60185. Phone is (312) 293-1050. Office address: Mail Station 355, Fermilab, Box 500, Batavia, Illinois 60510.

When I got back from San Diego, I realized with a shock that Capricorn was due the very next weekend. Somehow I lost a week in February; I'd thought I had more time to work on an apazine than really existed. And it takes me a lot of time just to compose a decent set of mailing comments. So herewith a minacine, with what I hope is some good reading. I'll put in some real hours in March doing a more substantial opus.

What, you may well ask, has been keeping me so busy? I spent a lot of time preparing a slide lecture on the history of aircars for Conquistador, where Barry Gehm and I were fan guests of honor. (I thriftily recycled the talk for Capricorn, and I may do so again.) I auditioned for a Möbius Theatre revue, *The Cast Who Walk through Walls*, and got the part—my first role ever with them. And I've continued to be active with local space groups, including the committee which is planning a national convention of space enthusiasts for 1989. Besides messing with antiprotons, cryogenics, and such. Forgive me for getting too busy; I promise March will be quieter...

MAILING COMMENTS ON APA-TECH 48

Jamie—Don't credit me with the proposal for a guest-edited issue of *PyroTechnics*; it originated with Mike Bentley. It's been seven years since Chicago did one, and we felt it might be time to do one again.// Glad you enjoy dancing. You look pretty good on the floor. Maybe I'll have to find some jitterbug lessons one of these days.// About that *Star Trek Eye Vee* cover: lampoons of the latest *Star Trek* or *Star Wars* flick are gonna appear in fanzines and art shows just as soon as the film opens. It's inevitable. If you don't go to see it right away, you'll have to resign yourself to missing the in-jokes.

I brought the term "fern bar" back from my trip to Colorado in 1981, where my old and dear friend Barb Budde explained, "This is Colorado, Bill. We put sprouts on *everything* here." I'm pretty sure it

came into currency among my group of friends (including Greg Ruffa) because I introduced it. Most people seemed unfamiliar with the term, and seized upon it as a perfect term for that certain kind of restaurant. And, speaking of restaurants, Greg took us to a place in San Diego that was *entirely a salad bar!* No menu, no entrees, just a lot of vegetables and some soup. Wow.// I like *Popular Communications*, and buy it occasionally, for its slants on weirdness and arcane radio history. Did you know there are places that will sell you working Hieronymus machines?// I have always faked umlauts on the Diablo or typewriter by backing up and overstriking a double quote mark over the vowel.

Guy C—I'd like to see the ideas in the Space Science Committee report. Those poor guys are (almost) completely at the mercy of NASA to get their work done, yet they have plenty of reason to hate NASA for its past and future abuses of astronomy, space physics, and planetary science.// Regional foods: On a couple occasions recently I've found myself in strange cities eating what was billed as "Chicago-Style Pizza." Here we just call it "pizza."

Bonnie—As all kinds of people will point out, Linda (who is about your age) has a *younger* sister—Donna Struwe Proni. This serves as an existence proof that you are not the youngest person in the apa. Who is? I dunno, is Kiran younger than Donna?// I felt the same way you did about *Eon*. I think of Bear as a writerly writer, even though I respect his command of the hard sciences, so it was startling to find that the early half of the book reads like a Jerry 'n' Larry novel. Good enough, but as it begins to open up into Stapledonian scope, *Eon* begins to get mushy. I got only a fuzzy idea of what was going on, why characters were motivated, and so forth.

The "Datashow" is certainly peculiar and wonderful. But don't you think it should be counted as a franking, not as something you wrote for the apa? Hmmm? I mean, if I could just xerox two pages of advertising every fourth month, I wouldn't have to write anything, would I? And if everybody did that, we might as well send Apa-Tech third class... (Don't take this too personally. The same criticism

applies to STEVE and to BARRY—I see you out there egoscanning, boys!—who at least had the honesty to title his apazine “Some Kind of Miserable Excuse for an Apazine.”)

Barry—This Ishercon was the worst I’ve ever seen for spreading disease. The day after I came home, I was down with the Nameless Plague, and I heard of five or six other attendees who met the same fate, including yourself.// Too bad Kurt Erichsen doesn’t read this apa. But he would understand your Ko-Ko joke if he did.

John—(Hmm, we seem to have lost John Frambach, so I don’t have to distinguish you guys. Shame.) (Although, of course, I still have to distinguish the other Guys.)

The latest titles in the Heterodyne Boys series are Phil Foglio’s *The Heterodyne Boys and the Mystery of the Cast-Iron Glacier* and my own *The Heterodyne Boys on the Plateau of Lost Autogiros*. The fire in your exhaust system reminds me of my friend Steve Paspek, a chemical engineer at Notre Dame who was trying to find new reactions to clean up automobile exhausts. Seems that the catalytic converters now in use employ an exothermic reaction, so the converter tends to run at a very high temperature. The catalyst includes platinum, and in the hot environment the platinum sublimates and slips out the pipe into the air, lost forever. Steve explained to me that he was working with alternative reactions which would run at lower temperatures. These might serve as the basis for a more economical converter.

“You’re barking up the wrong tree,” I told him. “What you *ought* to be working on is a gadget for extracting all that platinum vapor from the smog. You mount it in your car, drive around Los Angeles all day, and by supertime you open the trunk and take out a little nugget of platinum. Work out the details and you’ll be rich!” As far as I know, though, Steve never heeded my advice.

Bill Earls’ piece you reprinted has echoes of the “Good Old Days of GT” discussion in these pages some months ago. One of the sad things about aging is that the infinite options and possibilities a youngster faces are shut down, one by one, as the years go by. I can’t be a Teenage Software Wizard anymore, and I daresay you’ve given up hope of becoming a physicist. At some point you’re dead, and you have no more options at all.

Donna—Ishercon IX was a wonderful time for me, but I can see that it put a real strain on you, being five days long. (A Thursday or Wednesday New Year’s will do that to you.) I really liked the animated half-scale dinosaurs downtown, which nodded and wagged their tails and roared at museumgoers.

Now the question is: Who in GT will be the first to build his own motorized dinosaur?

I also think Steve Salaba’s film collection, and his willingness to share it with us, is one of the more endearing traditions. He deserves all the Oscars and popcorn machines we can give him. The tough part is picking out only one or two movies to show...

Like you, I worry about getting the chores done. Some guests seem to wind up doing the lion’s share of the cooking and cleaning, while others among us finish the weekend without having done much. As I’ve told you before, I think any individual who attends Ishercon would be happy to do the work if asked; the trouble is that not all of us are as fast at volunteering. If announcements were made loudly, all over the house, that dishes are now being done, or that we need two people to shell peas, I believe it would be easy to get a wide variety of workers.

The lottery system of pulling names out of a hat would probably work—but you’d have to make provision for somebody whose name comes up when he’s off looking at dinosaurs or shopping at Bicentennial Bookshop. Assign him to the next meal, and draw another name? And what about somebody whose name comes up, but hasn’t arrived yet or has already left? At any rate, I would find the lottery acceptable. The “Room Lottery” proposal stinks—it doesn’t spread the load among individuals, and what do you do if the room you pick has only one guy in it? What if it has twenty?

Here’s another scheme. At (or before) the beginning of the weekend, you designate a volunteer Crew Chief for preparing each meal, for cleanup, and for any other major labor. The Crew Chief is responsible for rounding up enough volunteers to get the job done in timely fashion. I’ve seen the dinner dishes languish for a long time, just because nobody felt it was his job to get them started—even though any one of them would gladly respond to a call for volunteers. You’d ask reliable “organizer types,” such as Alice or Mary Lynn, to be Crew Chiefs. I suppose the CC wouldn’t necessarily have to do the work herself, as long as she ensured that there were enough workers for the task. (This being the case, it might be fair to ask a good Crew Chief to organize more than one meal.) And, knowing the schedule in advance, they could round up their crews a day or two in advance if they wanted to. They could make an effort to spread the load among the guests. What a wonderful way to make newcomers feel wanted! I hereby volunteer to serve as a Crew Chief next year.

Let’s avoid getting too bogged down in exactly who is doing how much work—by all accounts, that was one of the least enjoyable features of Wilcon, the

Stopa's invitational con. If we can just make it easier for responsible guests to volunteer, we'll find we have plenty of hands to share the burden.

(I trust you'll get lots of mailing comments on your use of "diffuse," so that I don't have to mention it?)

Rod—Your zines are indeed spelled noticeably better, although I have to keep turning back to the title page to check who the author is. One less thing my overeducated brain is good for...// A "particle beam cannon" might indeed make a good reaction drive, as it would have an exhaust velocity near c . But it would probably have a very low thrust, maybe even lower than an ion engine of comparable weight, and a low thrust-to-weight ratio. You get high thrust by throwing a lot of mass overboard. This isn't a law of the universe, just the way the engineering tends to go. And mass-ratios are of order unity when the ship velocity is close to the exhaust velocity, so your drive would be most useful on a very-high-speed ($\gg .1c$) ship. For lower speeds a drive with higher thrust and mass flow, but lower exhaust velocity, would be more optimal.// Barry and I both oppose SDI, generally speaking. Are we "ignorant and seeking sensationalism?" And, yes, I frequently refer to the program as "Star Wars." Sue me. I have gone to some trouble to find an SDI proponent who might convince me that deploying an antimissile system was a good idea. So far, I find the opposing arguments more convincing. And, though I'm not an expert on all aspects of SDI, I don't think I'm more ignorant than you are...// I'm intrigued and puzzled by your comment to Valli: "I used to think that I was content to spend my life doing nothing but learning. That was before I went to college." Did college tell you there were other things to do in life, or did it sour you on learning? (The latter is hard to credit, as I know you to be a curious and widely-read fellow.)

I tell you three times:

ITS is the POSSESSIVE FORM: "Give the robot its bottle."

IT'S is the CONTRACTION for IT IS: "Thank Ghu it's Tuesday."

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IT'S is the CONTRACTION for IT IS: "Thank Ghu it's Tuesday."

It's true. I'm afraid you do have to rewrite your novel. (But surely your word processor has a "global substitution" command! 1. Substitute for every oc-

currence of "its" the string "zzz." 2. For every "it's," substitute "its." 3. For every "zzz," "it's.") I'd tell you the publisher's copy editors would take care of that, but in these sad days of the American Empire's decline, they probably don't know the difference between "its" and "it's" either.

Rolf: I used to drive the family's 1961 Corvair, which had big holes in the floor. After a June shower in Florida, some puddles would come right in over my sneakers. And Cuban culture demanded that Mama come along as a chaperone on her daughter's date; my parents worried that Mrs. Infante would go right through the floor some Saturday night.// Glad to see that Dan Cohn's books ended up in the ChUSFA Library, where he himself spent much of his time. I was thinking of sending them to Starehe in Kenya, but it takes about twenty-five bucks to send a box. Wonder if we could raise funds and books at some con?

Crumbcrunchers—Susannah, tell your word processor to set a stern limit on the number of exclamation points you use per thousand words of text! You never sound this breathless or excited in person! // I'd like to see the Computer Museum, too. During Boston in 1989, perhaps?// I got a science degree, too, but worked at getting a pretty liberal education. I think the physics and engineering has stuck with me more than the philosophy, theology, and history, though.

Steve—I'm a Stan Freberg fan, but I don't place "Widescreen Mama."// Were those ads from the *Motion Picture Handbook* typeset on a laser printer?

Bob and Connie—You will soon meet a dark and mysterious stranger on the net.// So, Bob, how do you like VMS? Or are you using Unix on the Vax?// I am befuddled about the "child-free Ishercon" controversy; I haven't heard from any of the people who opposed having kids. Of course I do recognize the difficulties, but if we're gonna raise a second generation, they should share in the Ishercon experience! (Including washing dishes when they're old enough; see above!)

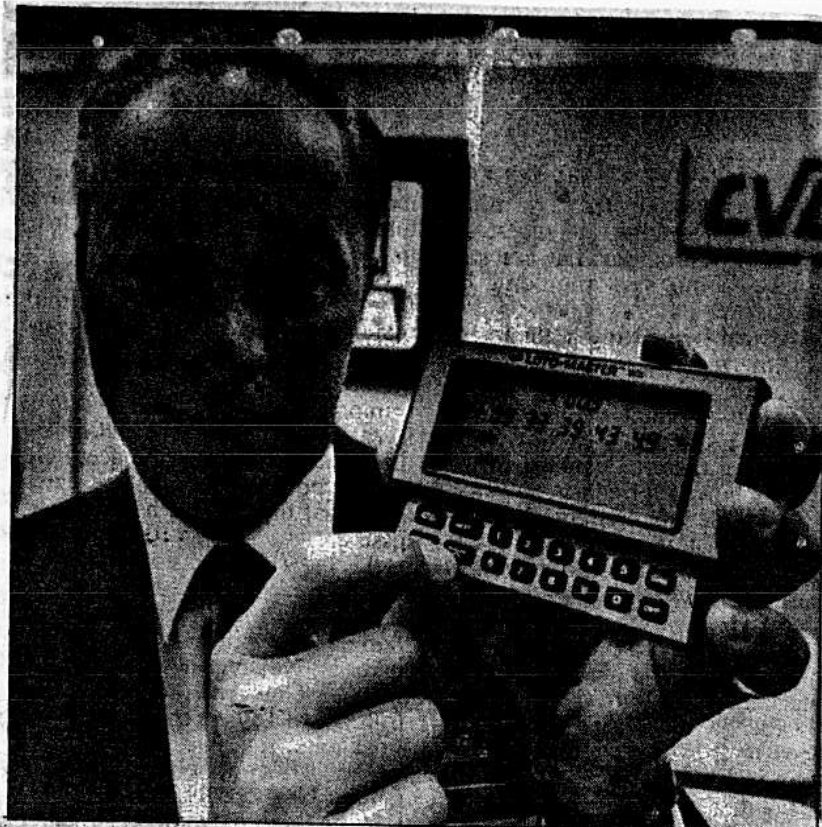
Guy W—I'm impressed that you really were able to concoct a Motie Macintosh for four hundred bucks, but not surprised (if a little disappointed) that you don't plan to do more. In my experience these things rarely work out. On the other hand, I did once fork over four kilodollars for 2400 pounds of Diablos...

Joa—Your criticism of the bomb-disarming game is well taken. Maybe you are more sensitive because you're from Europe. America hasn't had to deal much with terrorism on our home territory. I have noticed that all during the 1970's the European press, especially in Germany and Italy, seemed to be much more worked-up over terrorism than the American

press. Over here we can still treat it as a game. I pray it never gets to be as real on this side of the Atlantic.

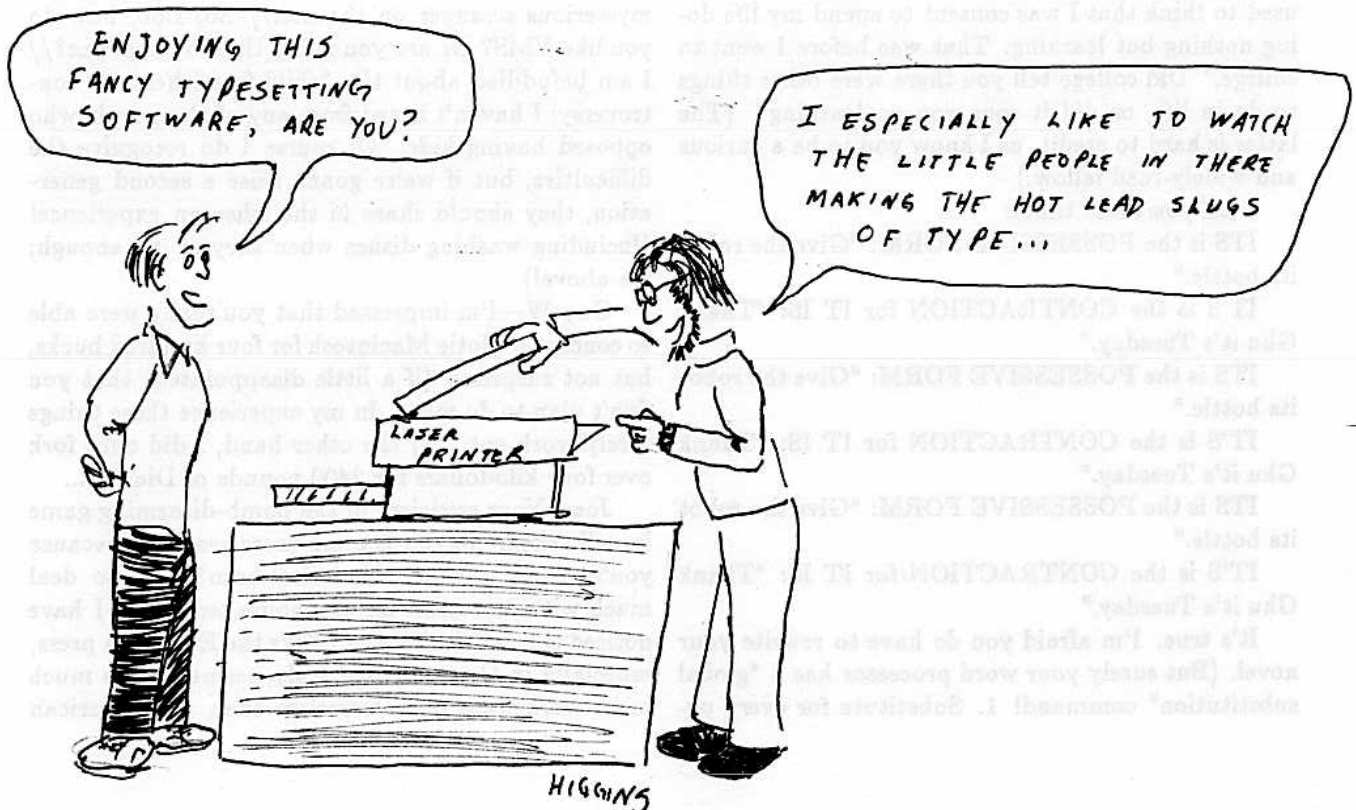
The challenges you set were very inventive, especially childproofing a space station. But why would you need "a Water Closet that can be used during heavy acceleration from unpredictable directions?" Seems like a rather unusual requirement. Do you plan to be the first to go over Niagara Falls sitting on a toilet? I have a foolproof way to render a wine glass invisible, a trick I learned from my high-school chemistry teacher. Put the glass in a large transparent vessel. Look in your *Rubber Handbook* for two miscible liquids, one which has an index of refraction larger than the wine glass, the other which has a smaller n . Then pour them into the vessel in the proper proportions so the resulting mixture matches the index of refraction of the glass. The glass disappears completely! The vessel appears to be filled only with liquid.

Valli—Mince! You talk about "loose hamburgers," ground beef cooked without being formed into patties. This is known to my family as "mince," and is a staple of our diet. You cook ground beef and a bit of water with maybe half an onion and a dash of coriander. It's great with Heinz 57 steak sauce—at least it was, until they changed the formula a couple of years ago (during the Classic Coke foolishness), making it sweeter and no fun at all. And is anybody else in this apa mad because the Gnome no longer appears on cans of Vernors'?



AP Laserphoto

Alex Moosz displays Loto-Master, a computer he says will allow a lottery player to program up to 18 favorite numbers to generate six-number groupings. Moosz' Quebec firm, CVDS Inc., is exhibiting the item at the Consumer Electronics Show.



Paranthetical Perambulations

(including Autobiographical Asides, Notes on Design Flaws of the Universe,
and other Assorted Wanderings)

Annette M. Kavanaugh
1401 E. 55th #1004-N
Chicago, Illinois 60615

First, a brief introduction . . .

More or less vital statistics: I am a programmer by trade and a mathematician by inclination. I've lived in Chicago since 1982, the year I came here as a transfer student at the University of Chicago. I went to school there with Diana Watson, whom some of the people from Lane Tech (e.g. Mike and Alice Bentley) remember; it was through her that I met Andy Anda and, through him, most of the folks represented herein.

I've been reading *ApaTech* for the last year or so, since Andy has prodigious numbers of back issues. I'd been interested in contributing something earlier, but had some doubt as to whether I had sufficient opinions/information/news on anything to fill more than a page. Hee hee, was I wrong. I had forgotten how much I like to burble and/or grouse about whatever book(s) I've read recently, the ideal form for an educational system (just about everybody's favorite soapbox, it seems), the social and political Shape of Things, nifty ideas and results in my field, and so forth. So here goes. (*Sound effects: champagne bottle breaking across bow of word processor*).

News, gossip, hearsay and innuendo

As 99.9% of the civilized world now knows (thanks to Andy), the two of us are Getting Hitched this month. Wedding preparations, like most logistical matters, are a ghastly bore, so I won't go the subject further except to say that the whole business is taking up a fair amount of time.

At the same time, we are getting replies from graduate schools. We both applied to Ph.D. programs in our respective fields at eight schools, back in December and January. (The eight institutions so dubiously honored are Maryland, Minnesota, Washington University in St. Louis, Cornell, Yale, Wisconsin, Purdue, and Illinois.) At the moment, I've gotten four replies and Andy has gotten one; they seem to take much longer processing the applications for the computer science department than those for the math department, probably because there are far more of the former. Andy's mom thinks that he is insane to leave his job at the Board of Trade. From time to time (generally in the wee hours of the morning) I also question our collective sanity, as we are leaving nice cushy civilian jobs to go forth and spend most of our time figuring out things we don't understand (and the other part it trying to teach bored undergraduates things *they* don't understand), live in grungy student housing on subsistence wages and experience once again the profound lack of sleep which seems to be the chief hallmark of the Life of the Mind.

The anarchists' club will come to order: notes on GT

I write this a few days after being at CapriCon, where I was embroiled in wonderful marathon discussions of Life, the Universe and Everything late into the night. This is great. Why didn't anybody tell me (especially in high school) that such people existed? I recall a lovely enumeration of the temptations of university life, the last of which (and the most enticing to me, above gambling, drinking, and duelling) was *good talk*. This was one of my chief reasons for wanting to go to college in the first place: this whole highly touted business of exchanging ideas and debating the Great Issues (one of which is *not* how drunk X got Saturday night). Surprisingly (or not, according to your prejudices) I didn't find this among the philosophy students with whom I studied my first two years. In fact, I didn't find it until I got to the University of Chicago, and then only in a select circle, chiefly among Diana and her friends.

The thing I like most about GT is that here, *enthusiasm is the order of the day*. In the last few months, in conversation and in the APA, I have heard/read people expressing great enthusiasm for: computer hardware and software, cars, kids, ideas (of all sorts, from dirigibles to SDI), and devices & doodads too numerous to list. In most parts of the world, this is not the rule. Nor is it usual, in most parts of the world, for people to discuss controversial things without shooting each other (rhetorically or literally). The people here have widely varying (and very strong) opinions, and no difficulty whatsoever in expressing them.

I like it here. I plan to stay.

And now, for some of *my* enthusiasms:

Neat stuff to read: Picture Books for the Thinking Person

Books (the buying, reading, talking-about and otherwise cherishing thereof) are one of my chief passions in life. One of the great joys of being a civilian (i.e. non-student) is the freedom to read what I want when I want. During my vacations from studenthood at the University of Chicago, I would go to my folks' house in Texas and decompress by devouring all the reading material in sight. This included the six months' worth of *Fantasy and Science Fiction*, *Asimov's*, and *Analog* that had accumulated in my absence, whatever articles struck my fancy in *Scientific American* and *American Scientist*, and random novels brought home in the backpack or picked up off the folks' bookshelves. Acknowledgement (i.e. eternal gratitude) is due to the folks for keeping a well-stocked library at home, subscribing to more magazines than any mortal could keep up with, and providing all of us kids with public library cards as soon as we could sound out more than three words.

So today I am going to talk about a special class of Fun Books: the mathematical picture book.

No discussion of this subject is complete without at least a mention of M. C. Escher, whose work invariably surfaces as examples in various mathematical contexts. So I've included two books on Escher and his work:

The Infinite World of M.C. Escher. Abradale Press/Harry H. Abrams, Inc., New York.

This book is still in print, after a fashion: I recently saw it in the remainders

sections in the University of Chicago bookstore. It is a catalogue of Escher's major works which also includes some of his earlier, more conventional prints. There's an introductory essay in the beginning of the book, which puts Escher's work in historical and artistic perspective (if such questions interest you) and discusses how his artistic priorities differ from those of more "respectable" modern artists. There is also a short essay by Escher himself, called "Approaches to Infinity."

The Magic Mirror of M. C. Escher. Bruno Ernst, Ballantine Books: New York, 1976.

This is the more interesting of these two books on Escher. As you would expect, there are reproductions of the major works (although the quality of said reproductions is not quite as nice as in the book reviewed above). The point of real interest to me was the text, which discusses in outline the mathematical ideas underlying Escher's pictures, and the reproductions of some of Escher's preliminary studies for his most famous prints. These studies include grids of logarithmic spirals, architectural studies in curvilinear perspective, and the successive workings-through of some of the more striking "optical illusions" which appear in the prints. There's also some interesting biographical information on Escher himself. (I was quite surprised to learn that he was entirely untutored in advanced mathematics, although his works invariably turn up as illustrative examples in texts on such relatively arcane subjects as the theory of symmetric groups.)

My only quibble with this book, which is lovely in all other respects, is that it lacks any attempt at a formal bibliography. For those who want to pursue in detail some of the intriguing topics introduced in this relatively slender book, this is rather frustrating.

Handbook of Regular Patterns: An Introduction to Symmetry in Two Dimensions. Peter Stevens, MIT Press, 1982.

Two-dimensional crystallographic group theory, for artists. This is a gorgeous compendium of decorative patterns (tilings, manuscript illuminations, textile designs, etcetera), classified by their group structure. Because it is written for an audience which is not assumed to have facility with mathematical formalism, there is very little to master by way of notation: the material is presented through pictures and (invariably visual) experiments, which the reader is called upon to pause and try. A quick time-out for one of my favorite education soapboxes: there ought to be more books like this, since linear perspective is not the only mathematical system which is of use to practicing artists. I decided against going to art school, but the impression I get from people who have gone is that even such classic disciplines as perspective and anatomy are not stressed much these days. Why is mathematics (particularly geometry) so scorned by the art world, when it offers such a wealth of esthetically compelling forms to build upon?

Inversions: a catalogue of calligraphic cartwheels. Scott Kim; introduction by Douglas Hofstadter. BYTE Books (McGraw-Hill), 1981. *Out of print, I am told. Try to find it used.*

Variations on the theme introduced in the books reviewed above, using calligraphy as the medium. This month's ApaTech cover is a (relatively simple) example of the sort of thing to be found within. Lots of people have seen this book; I discovered it relatively recently (it was a Christmas gift from Andy). Definitely a whole lot more

fun than your average book on calligraphy.

Shapes, Space and Symmetry. Alan Holden, Columbia University Press, 1986.

Soapbox time again: have you noticed that they don't teach solid geometry in high school anymore? (Nor anywhere else, for that matter.) I always figured that I missed it because my high schools all had somewhat deficient science curricula, but not so: it turns out that hardly anybody learns this stuff anymore. This book takes a first step toward ameliorating the situation: it is an informal, qualitative (rather than quantitative) introduction to the regular solids; the author uses photographs of wire and cardboard models of these solids to illustrate his elegant explanations of their symmetry properties. There's a really nice verbal and visual explanation of the geometric notion of duality (which will be very useful to have seen if you ever decide to look into projective geometry), as well as an exhaustive enumeration of the planes and axes of symmetry of all the Platonic solids. From this basic beginning (which takes up the first twenty-some pages of the book), Holden proceeds to display combinations of different regular solids, some of which are quite reasonably described as "monsters". He introduces the Kepler-Poinsot solids (star polyhedra), various of the semiregular polyhedra, and finishes up with a discussion of the stacking of polyhedra in space (with obvious applications to crystallography). At the very end, he briefly introduces the notion of a knot in space.

This is a wonderful book. First of all, *there are no formulas in it*. This may seem an odd recommendation from a mathematician, but geometry is a subject which is best approached from a qualitative point of view at first (in my opinion, anyway). Holden urges his readers to construct the models depicted in the book's illustrations, and even gives instructions for doing so easily. If, after reading a section of the book, you're curious as to why all this is so, there are lots of nice geometry books which will give you rigorous explanations; I personally recommend the books of H. Coxeter, particularly *Regular Polytopes* (which is available in a Dover reprint) and *Introduction to Geometry*. The first-mentioned of these volumes satisfied my curiosity on a lot of points in Holden's book, and made me feel exceedingly humble about the great amount of trigonometry I had forgotten.

We come to the end, alas too soon

I'd intended to include a few more volumes in the above book column; however, time grows short: it's 25 February and if I want this to get to its destination by the deadline, I'd best wind it up. So long until next month.

Technical notes: The foregoing was produced on a Hewlett-Packard LaserJet printer (at work: O how I lust after this wondrous gadget); the word processor was a piece of junk called Uniplex-II which I have jazzed up a tad so that you can feed its output through a program my boss wrote to translate certain character sequences to LaserJet print commands. The bugger does not handle proportional fonts AT ALL, so I will never have a justified right margin.

(Yet another regret about going to grad school: I won't have these wonderful toys to play with any more.)

TRANSPORTER

TOPICS

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Number 43

Spaceflight

Bad news for those of you who have been rooting for the Jarvis Medium Launch Vehicle. Due mostly to cooperation problems between Rocketdyne, which manufactured the Saturn engines intended for the original Jarvis, and Hughes and Boeing, who are trying to build the thing, there is a new version which is more expensive, more complicated and has a smaller capacity. It seems that Rocketdyne also makes the Space Shuttle Main Engine. It is much more profitable to sell these than to reopen the Saturn production lines. Strange that no one with any of the companies involved has mentioned that there are enough F-1 and J-2 engines in factory sealed storage to build up to five complete vehicles. If refurbished display engines were used more could be built.

Boeing has pretty much taken the project out of the hands of Hughes, which came up with the idea. Now Boeing is promoting this "new" concept, which is actually a reworking of a vehicle design they had come up with earlier which was rejected. Small wonder that the Air Force has eliminated the Jarvis from competition.

Orbital Sciences, which has been getting the runaround from NASA for years in their efforts to become an independent rocket manufacturer, has finally been awarded a contract. They are to build the upper stage for the Mars Observer Probe.

The Soviets lost a Proton booster on Jan 30. The fourth stage exploded late in the launch. The administration tried to cover it up but failed.

Other High-Tech Stuff

Argonne National Labs has announced the development of a new type of fuel cell. It is lightweight, simply constructed and has such a high power density that it could make the electric airplane a reality. It actually has twice the power and fuel efficiency of a similarly sized internal combustion engine.

I strongly recommend Engines of Creation, by Eric Drexler. I haven't read much of it yet but have been following his articles in magazines. Nanotechnology is the next revolution, folks. It may be the greatest single technical development in the history of Humanity.

Work

I am campaigning for a Compaq Deskpro 386 to use for running the traffic model. Yes, they have decided to revive the Transportation Simulation Network. My bosses seems to have no idea of computer capacities; they tried to get me to run this on

an XT. Since the second longest program took over an hour to run on someone else's AT with my data, you can see that I need something faster. There is also the fact that two other people already use the same computer that I do, meaning that it is often busy for long periods and that the hard disk is nearly full.

The powers that be are even making it difficult to get enough floppy disks. I had to talk to the division director to convince him that I needed a box of ten. He was very surprised to learn just how little they hold.

The last week in February I am attending a new manager's workshop, as part of a state program to train employees for internal promotion opportunities.

Comics

The new comic, Alien Fire, is one of the few examples of genuine hard science fiction in the medium. The internal art needs some work but the front and back covers are beautiful. The story concerns a mixed-species interstellar trading crew, one of whom is human. Earth had an ecological disaster several decades before, resulting in the collapse of civilization. Pre-collapse artifacts are now collector's items and the sole human in the crew is along as their advisor. It is hard to evaluate a comic from one issue but this one shows promise.

My Doom Patrol article has finally been published. I haven't been paid yet but expect the check by the end of the month. (Still waiting as this is sent in.)

Driving

From the accounts published here, bad driving in most places seems to be caused by misplaced aggression. People in this area drive badly because of ignorance. Lexington has had changeable lanes for two or three years, with lights controlling the use of lanes at different times of the day. You still see people making left turns from a through lane, driving down a turn lane and even trying to drive against oncoming traffic.

Mailing Comments

Chair: Well, the carrot-and-stick approach does tend to work.

Jamie: Welcome back. Sorry to hear about you and Gail. I suppose it is better to know when to quit than to let things drag on uncomfortably for both parties. * Has Issue R38 of Pyro been mailed yet? I don't think I got it. * A good hobby can help a person get his or her life organized. Karate has helped me. * When I saw the "Latex" heading I was anticipating something pleasantly kinky. * Don't get an IBM clone. The new Amiga 2000 is faster, more powerful and can access more RAM and disk memory. It can use XT and AT boards and be made fully compatible. It also starts at \$1500. * Re. yr. tale of a traffic accident: My reflexes are so quick that I have trouble getting into synch with other drivers. Just as I decide that the car at the other stop sign isn't going to move and start forward with my own car, the driver finishes looking and decides that it's safe to move. *

Easton Letter: Re. lost notes: I know the feeling. * I love

driving after a good, heavy snow. No one else is out, so the roads are safe. * A fellow at work cut the Doonesbury cartoons out, but I never saw the finished product. * Have you read Black and Blue Magic? I, too, enjoyed the mushroom planet books. *

Fractured Flickers: (A pun here. You flick your fingers. Anybody recognize the other reference?) * I don't know whether you touch type, but even hunt-and-peck must be difficult with a splint on one finger. The reminds me of a *Thunderbunny* episode. The hero of this comic can change into a giant, super-powered pink rabbit (so help me, this is a legitimate book and a very good one). In one story he has to type a message on a terminal. He knows how to touch type, but since the rabbit is missing human pinkies has to h-a-p instead, with much difficulty. * I am 31, and the oldest member of my gaming group, but feel nearly the youngest. It's all in your mind. You could try my solution to looking older, but I don't think you would look good with a mustache. * More! *

Excuses, excuses...: Re. Yr. Cmmt. word processors: I know the feeling. * With all the attendies who got the flu at Ishercon, I'm beginning to be glad I missed it. * More! *

Flaming Vehicles: None of my cars have ever caught fire (maybe because I keep an extinguisher in the back seat) but a friend's VW beetle I was in did. * Like your title explanation. Have you ever read any of the Tom Swift Senior stories? *

Hidden Bullets: Again, I missed Ishercon. Maybe next year. See below, under stomach, for partial explanation. I definitely enjoy children and get along with them better than I do with most adults. It's the beard; they think I'm a pet. * A couple of fannish friends have some of those pop guns. They're fun, and enough unlike real guns that they aren't likely to teach bad firearms handling habits. *

Strange Feline Diets: I'm going to need a car sometime in the next year or two. Unfortunately, the one I want costs around \$20K. * I burned out on D&D back in college. I have tried reviving my interest a couple of times, with mixed results. * Re. Yr. Cmmt. Crumcrunchers: If you want a thick milkshake, try one of my Infamous Pink Milkshakes. Sometimes I even put a dash of wheat germ in for extra body. * Re. Yr. Cmmt. Dr. Gonzo: Sounds like my hometown. *

Crumcrunchers: "Microtechies"; I love it! * I don't have a problem with my shower, since it is in the basement, but my kitchen sink leaks around the edges and the water drips all the way down into the basement, onto my washer and dryer. *

Red Hot Widescreen: More! *

Rug Rats Inc.: (Two titles with nicknames for children. Hmmm, this means something.) See my comments above about children. * My sympathies on your and Connie's troubles. *

Connie: I am very sorry to hear about your miscarriage. Humans have so much trouble reproducing it is surprising that there are so many of us. Comes from being neotenous, I suppose. We just aren't adult enough to do the job properly. *

Delusions and Madness: Glad to hear that your employer is doing well. * More! *

Technology: Whenever I read your 'zine it comes across with a German accent. I don't know whether it is because I am aware of your origins or because you write with the same sort of rythms that German people use when speaking English. * I used to do a lot of DX listening and hope to resume the hobby in the future. * You probably dislike the bombs for the same reasons I dislike those games where people shoot each other with paintballs. * NASA has already tested at least two designs for a zero-g softdrink can, one Pepsi and the other Coke. Neither got rave reviews. *

Dr. Gonzo: Sounds like an interesting gettogether. *

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Stomach Troubles

For over two years I have been suffering from come-and-go problems with my digestive tract. It finally dawned on me that I was having a relapse every time I baked bread. I asked around and found out that, yes, ordinary baker's yeast can live and thrive in the human gut. I am an enthusiastic but messy cook. Apparently, every time I opened a package of yeast I re-infected myself. The cure is simple; replace the yeast with something benevolent. You can eat yogurt if you like it. I don't, so I take freeze dried lactobacillus tablets. They help a lot, although I still have minor outbreaks.

This is one of those things which is seriously inconvenient without being life threatening. During an attack I have to be very careful. I can't eat or drink anything with lots of sugar or acid. I also have to eat the stuff I can almost constantly, to help flush the yeast and their waste products along. Otherwise I start getting nauseous. I keep antacid tablets handy at all times.

Imagine how this affects my social life. I have to avoid situations where I will be away from the right kind of food for long periods. Most common foods make things worse. It encourages my already hermit-like nature. Fortunately (though not for her), one member of my usual fannish group is seriously hypoglycemic and has to be even more careful with her diet than I do, so there is a strong mutual understanding.

Office Blues

Well, I'm not going to get the Compaq 386 I wanted. They have convinced me to settle for an AT with a math coprocessor.

Rubicon

This is a very small con which is nevertheless more for people from out of town than for locals. These are primarily from Ohio ("crossing the Rubicon"; get it?). It was a bit too tame this year. The video room was in mine, and we showed mostly my tapes. I made some new converts to japanese animation by showing "Harmageddon."

See ya in 30!
Rod

YA GOTTA WAKE UP
AND SMELL THE CORFLU

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[WARNING: This document promotes secular humanist values
and may not be suitable for publication in Alabama or Tennessee.]

* * *

This is very late again, as this is turning into a very messy month. I'm trying to get the manuscript for my Mars paper out of here, since the electric propulsion conference was supposed to have it in their hands a week ago. Unfortunately, I've been on jury duty downtown all this past week. I sat through two selections and almost got out Friday, which would have made me a second-string candidate the next week and might not have been called again at all. Instead, I wound up as second alternate juror on a case that could take two weeks to present. Forget whatever you've seen on TV or in the movies: courtroom dramas do little to convey the boredom of actual proceedings or the triviality of most incidents that end up in litigation.

Needless to say, this isn't doing much for my schedule. I just got around to sitting down on the floor and collating the rest of the APA. I'll tap this out as fast as I can and mail this from downtown tomorrow; I'm afraid I'll have to forgo mailing comments until next month. (I had some on diskette for #46, but they were really stale when I re-read them.)

* * *

What I've been doing a lot of mornings since I last wrote is getting out of bed and shambling over to this machine to get some writing done. I've done the post-flight analysis for AC-66 (Atlas/Centaur #66, for you newer folks): it was a good launch -- very nominal, as they say. I'm going over the first check copy for the FLTSATCOM (geosynchronous communications satellites for the Navy) trajectory design report. In that, after I talk about the general mission, the launch vehicle, and the satellite (it was some fun trying to dig up enough stuff to write about there -- one of my sources is **Aviation Week**), I write about what I did to find the most fuel-efficient trajectories to get the spacecraft where they're going (I didn't write any of the programs -- I just know what they do and how to use them). Now I'm trying to get my results pulled together on my simulations of ion-engine flights to Mars and back; as soon as Cordell agrees that it looks OK, it goes to New York; then we'll work on getting the company to clear it for publication. (That's not the correct order, but there's nothing classified or proprietary in the paper.) So my APAzines and a couple other things have had to sit.

As some of you are already aware, we got more bad news at work. The Medium Launch Vehicle is going to be built by McDonnell Douglas as the Delta-II, which cites as its key to reliability the fact that it uses very little new technology compared to what's in the Delta 3920. Since the Air Force only wanted it to launch Navstars, which weigh about a ton, into 12-hour orbits, it isn't too surprising that Atlas didn't get picked -- it really is too big for the job. [Which means, by the way, Rod, that the Jarvis is vastly oversized for the program; but don't give up hope, there's still HLV, about which more below.] The bad news for Space Systems is that no one is buying boosters from us any time soon, so business is still rather slow. The bad

news for me is that there will be no money for Mars research this year, which is one more prompt for me to move on later this year.

Our next launch is scheduled for March 26th: that'll be for AC-67, carrying another FLTSATCOM. The last Atlas-G booster left here about a week ago and is set to go sometime in June. The Division is trying to come up with something for the plant workers to do until they need them to make upper stages for Titan/Centaur late this year; it's more likely there'll just be more layoffs down there. Another Trajectory and Performance person left for Denver last Friday. Meanwhile, Flight Mechanics is actually interviewing people: we lost so many folks in Guidance and Control that they're getting critically shorthanded.

That's not the only place where we're running out of people. I'm starting to read a pile of stuff on radiothermal generators (RTGs) in order to become an expert on hazard analysis; the two men in the Division who still know how to do this will retire within the next few years (I hate to tell them that I may be gone before they are). I've learned some interesting things already, one of which is that Galileo and Ulysses would not have been launched last year even if **Challenger** hadn't been destroyed. Galileo carries some 40 pounds of plutonium-238 (half-life: 89 years) and Ulysses holds half that much. The RTGs have only modest structural strength: they have to have enough integrity to survive launch vehicle destruction by range safety officers, but also have to be able to disintegrate on re-entry from an orbital mishap so that their contents (or "inventory") can disperse over the widest possible area (rather smash on impact and make a rather small locale quite "hot"). This all posed no problem for Pioneer and Voyager, which were launched on Titan/Centaurs. In an explosion like that of Mission 51-L, however, the Shuttle/Centaur would likely have ignited and driven Galileo straight into the forward bulkhead of the orbiter bay, which is a well-reinforced wall (it survived the **Challenger** disaster intact). Independent study indicated that the average release of plutonium from various possible Shuttle accidents differed little from total release, whereas other vehicle failures show an average release of a very small fraction of inventory. Had nothing happened out of the ordinary in January of 1986, a report would have reached the National Security Council and the President by March that would have probably forced a decision to cancel the Galileo and Ulysses launches and to conduct a Congressional investigation of the programs. So, for me, the moral is that you're not always in as bad a time-line as you think you are...

The other major program I'm involved with right now is the Heavy-Lift Launch Vehicle (more fun with the folks in the Crystal Palace). I have some qualms being tangled up with this, in large part because the funding is from SDIO; the way I figure it, though, HLLV, SDI, or I will go away soon. Besides, NASA is getting a hand into some of it now, too. The overall scheme is to have a rocket ready in 1993 (first test flight in summer of 1992) that can put 100,000 pounds into low Earth orbit; from there, a sequence of improvements will bring that capacity to 150,000 pounds. The stated goal, however, is to reduce launch costs by a factor of three by 1993 and cut them by a factor of ten by, say, 2001. If this really works, payloads will cost under \$500 per pound to take to orbit by the turn of the century. It's clear enough why SDIO wants this; what is interesting is that NASA is finally beginning to think about using it to put up at least some of the Space Station (so we could have 24-foot-diameter modules, instead of 14-foot ones).

Right now, we're studying what is being called the Fly-back Booster, which will be used around 2000 to assist the launch of HLLV. Instead of using strap-on solid rockets, the core vehicle will be lifted by a single (mebbe) reusable rocket. For Vandenberg launches, you have to imagine a robot cruise missile the size of a DC-10 flying back from 300,000 feet, down past Los Angeles, and onto a runway at the Air Force base. All this will give us Saturn-class vehicles that will be half

the size of a Saturn-V and much cheaper than anything we have now. NASA is looking into using this as a launcher for Shuttle-II (as soon as they decide what that looks like...). Don't get too excited: passenger tickets would still cost on the order of \$75,000.

(And if you believe all this will really happen just that way by 2001, I'll have Higgins give you a ride in his aircar...)

* * *

One of the other things I'm supposed to be doing [I mean besides the Concordance, Rolf...] is getting out the local AIAA Newsletter. I'm still Publications Chairman and Newsletter Editor for the San Diego section until June, but they've been keeping me busy just getting out the meeting announcements. The manned Mars mission talk is this Thursday with James French (but what I really want to ask him about is American Rocket Company's hybrid booster, which they're supposed to launch within another year). In April, we have a talk on space resources and industrialization with a local specialist (whom Bill and I had the "pleasure" of being on three panels with at Conquistador). The Section has some involvement with a big celebration in May of the 60th anniversary of Charles Lindbergh's transatlantic flight, which started from here. There will be dinners and presentations on the appropriate anniversaries in San Diego, St. Louis, New York City, and Paris; for something like \$3000, you can join the planned city-hopping with a return on the Concorde!

I was also notified by phone last month that my application was received favorably (my Engineering Chief got the Vice-President for Programs to sign it) and that I am a member of the AIAA National Technical Committee for Space Sciences and Astronomy. I am supposed to meet with other members two or three times a year to confer, converse, and otherwise hob-nob and help decide Institute policy on issues in the appropriate fields. The company ain't sending me anywhere, however, until I get written confirmation on my appointment and on the next meeting. It's been five weeks, so now I have to call the guy I talked to, find out what the scoop is (or to let me in on the gag...).
to

So I actually have quite an itinerary for the next several months. The Committee meeting is April 30th in Crystal City, Virginia (what I've come to think of as a suburb of the Pentagon). The electric propulsion conference where I'm supposed to present my paper (which I really must get back to) is in Colorado Springs from May 11 to 13. Sometime around then, there is a seminar on RTGs at NASA Lewis Research Center in Cleveland that I'm being sent to. (I just had a weird thought: if they hold the seminar the week before the conference, I could go to Marcon.) I'm taking a week's vacation at the start of June to visit back home and go to my cousin Chuck's wedding. The Case for Mars III conference is being held in Boulder from July 18 to 22: Cordell and I have declared to each other that we will take leave and go at our own expense if GD won't send us. Then, of course, in September, I'll be going to Phoenix (I decided there's little sense in going to Brighton if I can't spend a couple of weeks visiting England; money could be a problem, as well). As soon as I get information on hotels, I'll be looking for roommates; I'll probably get the now traditional two doubles. I'm also planning for a formal dinner once again, even though it isn't Worldcon...

I've fallen into the pit of consumerist profligacy and bought the last things I've been wanting to get. (Besides, I'm out of space: the bicycle is parked in the second bathroom as it is...) I got an Epson EX-800 for the Amiga. I doubt I'm going to do documents or 'zines on it (although the letter-quality font is pretty good), but life is somewhat easier when you can de-bug program listings on paper (I found

the problem in the hyperbolic trajectory part of my ion-engine flight program in a couple hours), mark up manuscript drafts, and send heaps of data instead of having to scribble it down off the screen. Marvellous invention -- everyone should have one! I replaced my one-piece stereo with a Fisher system, which includes a compact-disc player. The improvement in sound quality is wonderful and certainly good enough for the room acoustics. Now I guess I need some CDs... And... well... I broke down and... oh, I'm so ashamed... went out Friday and bought a TV and a VCR (there, I said it!). After living without video for 2½ years, I think I've developed the habit by now not to run over all the time to see what's on television (I watched some on Saturday and was satisfied that there isn't much I want to see -- and I still think TV news stinks!!). But I'd like to be able to pick up copies of old movies I've been wanting to see without having to wait for the Ken to get around to them. So saying, I found out this weekend how hard it is to rent movies without a credit card. (I never cared to own one and I now find I can't get one because I don't have one. I recently tried to get a "secured" credit card -- looks just like the real thing -- and found out that I'd have to guarantee that I'd keep the money tied up for a year, which I couldn't do since I'm not planning to be here another year. This, despite having a checking account at that bank for over two years. TANJ!)

* * *

I won't write a whole lot about Conquistador, as I want to reserve that fun for Msrs. Gehm and Higgins (and they'd get mad if I stole their lines...). I got out of work early to get down to the hotel around three on Friday and spent a good part of the next week with them. The weather was putting on quite a show for them over the weekend, being unseasonably sunny and in the 70s (today is more normal-like, being mostly cloudy, in the low 60s, with some hail around 7 AM). Certainly the weather found an appreciative audience in them, with breakfasting on the balcony and Barry trying to get a tan.

Bill was on something like seven panels or events and Barry on three or four; San Diegans are crazy for programming at cons (the Westercon here last year had eleven tracks) and they like to make guests work off their free memberships. Both Bill's "aircar" talk and the Bill and Barry Show were quite well-attended (for a con of around 300 people and starting at 5 PM, the Show brought in -- or is that, "took in" -- between forty and fifty people). The Boys (and their robotic surrogates) were a big hit; it must have been very gratifying to have people come up to them in the hallway and tell them how great the Show was. I guess that shows that Southern Californians laugh at a lot of the same things as regular people...

The skies turned back to overcast and occasional rain until the next Saturday. I took Monday and Tuesday off to show the guys around. We got a tour of the Aerospace Museum in Balboa Park from one of the Directors (who happens to be on the AIAA Section Council -- my being on the Council has to be good for something). Part of the reason I made this arrangement was so we could get a look in the basement, where aircraft are restored for exhibition; Bill particularly seemed to enjoy that. After lunch, we went to the Space Theater to see the OMNIMAX film, "On the Wing," about all manner of flight (and featuring *Quetzalcoatl northropii*). Then we walked around some more of the Park and got rained on. We spent a good part of a gloomy Tuesday in my rooms, with Bill and I boring Barry as we talked about space stuff. They rented a car Wednesday and drove up to Los Angeles to visit Nikki Ballard and Mike Toman and JPL [Barry, you're going to have to come up with a list of tour spots of biochemical interest...]. Unhappily, they got subjected to some of our real winter driving back Friday and found out how people here drive in the rain. I hope they were somewhat cheered when we went to the Festival of Animation that night. I saw them off at the airport Saturday afternoon.

Sulfa now -- amine to write again next month...

Can DD Make a Rocket So Heavy that They Can't Lift It?

... and other pointless philosophical disquisitions

— compiled by Greg Ruffa —

USAF Seeks Technology to Cut Heavy-Lift Launch Costs

Washington—The planned military heavy-lift launch vehicle must be based on new technology to achieve the Air Force's goal of reducing launch costs to at least one-third of what they are today, according to senior Air Force space planners.

Development of the new heavy-lift launch vehicle using either Titan 4 or space shuttle technology as a starting point is a "bankrupt idea," a senior Air Force official closely involved with the program said. He said that although funds for the new launcher have been requested by the Strategic Defense Initiative Organization, other Defense space users also require the launcher. "It is not simply an SDI issue. It's a national issue," he said.

"An economical launch vehicle is the thing we're going for," the official said. The 150,000-lb. payload capability goal is not as important to the Defense Dept. as reducing launch costs. The objective is to reduce to no more than one-third of today's launch costs, with an ultimate goal of one-tenth. The Air Force believes reduced costs are technically achievable, but cannot be accomplished with Titan or shuttle-derived launch systems.

Titan 4 and the space shuttle are experiencing problems that concern military space planners who plan on using both

systems in 1988. The most serious Titan 4 problem was a spacecraft firing test failure in November, when the structure collapsed during a pressurization test (AWST Jan. 19, p. 31). McDonnell Douglas, the firing contractor, determined that a design error had been made, which has since been corrected. The new firing must be available for the first Titan 4 launch in late 1988 or early 1989.

Titan 4 will be able to launch 10,000 lb. into geostationary orbit, as the \$3-billion contract specifies, according to the senior Air Force official. However, he said Titan 4 will not be able to launch weights higher than that. Martin Marietta, the Titan prime contractor, set higher lift capabilities as a goal and used them as a selling point when Titan 4 was competing for the Complementary Expendable Launch Vehicle contract. The Air Force official said. But the development program has shown that the upgrade will not be possible.

The space shuttle will be unable to launch 65,000 lb. from Kennedy Space Center and 32,000 lb. from Vandenberg. The respective payload capabilities originally designated for the shuttle. NASA has informed the Air Force that the shuttle's estimated payload capability from Kennedy will be 51,000 lb. New payload estimates for the shuttle from Vandenberg

are still being refined, but they appear to be much less than those required by the Defense Dept.

Air Force planners were using 16,000 lb. as the revised shuttle capability for Vandenberg, which was inadequate for most projected launches from the West Coast. NASA has informed the Air Force that Vandenberg launch capability for the shuttle should be higher than 16,000 lb., but how much higher remains in question.

Shuttle program officials will have to approve the use of 100% shuttle main engine thrust and solid rocket booster flammant-wound cases to increase the capability from Vandenberg, but both program elements have been shelved temporarily by guidelines that call for a new conservative attitude toward safety. In any case, NASA was "some point away from being ready to sign off" on using the flammant-wound cases, the Air Force official said. These problems prompted the recent Air Force decision to reduce the shuttle work force at Vandenberg, leaving the shuttle launch complex in caretaker status.

Even if NASA can increase the shuttle's payload capability to 20,000 lb. from the West Coast, "that's still not sufficient for us to use Vandenberg," the Air Force official said. "We have to have something well over 20,000 lb." []

International Mars Mission Proposed To Energize U. S. Space Program

By Richard G. O'Leone

Reno, Nev.—A leading U. S. scientist proposed that the U. S. energize its flagging interplanetary exploration program by initiating a Mars sample return mission in collaboration with the Soviet Union and Europe.

In what he termed a "bold augmentation" of the nation's currently planned interplanetary effort, Jet Propulsion Laboratory director Lew Allen proposed that work be started in 1992 for a launch in 1996. "There is a place in the U. S. space program for challenging missions to the planets," Allen told the 25th aerospace sciences meeting of the American Institute of Aeronautics and Astronautics.

Advanced Roving Vehicle

Allen said that in a scenario currently being studied, the U. S. would provide a sophisticated roving vehicle with the capability for in situ sampling and analysis. "The Soviets would provide a much simpler lander, but with a sample return capability," he said. "An attempt would be made to bring the two together."

The European Space Agency has indicated interest in participating but is not certain the Europeans can afford it, he said.

The JPL director said such a program should be collaborative, rather than joint, so that each nation can avoid becoming entangled with another's hardware, budget and schedule problems. Each participant would design a program that is justifiable on its own but would be improved if coordinated with another nation's mission, he said.

The proposal by Allen, recipient of the AIAA's von Karman Astronautics lectureship, came as he concluded a presentation that took a generally gloomy view of the U. S. interplanetary program. The triumphs of the 1960s and 1970s culminated with the launch of the Voyagers in 1977, and while these highly successful spacecraft continued to perform splendidly in the 1980s, they are the last planetary missions the U. S. has launched, he said.

"We had boldly gone where no man has gone before, but now what?" he asked. "Why has planetary exploration come to a stop?" He gave these reasons:

- The Challenger accident, which halted shuttle flights and led to abandonment of the Centaur upper stage for safety reasons.
- NASA's current priority is recovery of the space shuttle program, with its primary mission of supporting the space station. Space science must fit into the shuttle/space station operation.

- Costs have risen as the programs became more complex and ambitious, leading to a decline in the number of missions. This led many scientists and engineers to seek other fields, and "the foundation on which America's success in space had been built was eroding." The Solar System Exploration Committee formulated a "remarkable" plan to remedy this problem, but it has been only partially implemented.
- Competition from other NASA science programs, notably astrophysics and earth science, puts planetary missions at a disadvantage. "Planetary exploration is not competing well," perhaps because the glamour of the early discovery missions has worn off.
- International politics, rather than scientific objectives, have sometimes influenced U. S. space efforts. "As we stand nearly idle in the '80s, we need to sort out the politics of planets in order to go on."

The prospect of Mars missions and possible collaboration with the Soviet Union were subjects of considerable discussion throughout the meeting (AWST Dec. 8, 1986, p. 11). Another scientist, Noel W. Hinners, endorsed the concept "if correctly structured." Hinners, director of God-

dard Space Flight Center, said a manned Mars mission is "large, complex and expensive enough" to make collaboration with the Soviet Union desirable, in addition to enhancing world peace.

Hinners echoed Allen's lament about the state of the U. S. space science effort, which he called in "crisis." The Challenger accident exacerbated a situation where fewer missions were available for increasing scientific needs, he said.

He warned that "undue conservatism" in revising the shuttle program could hurt scientific programs that use secondary payloads. As an example, he cited the fact that the first shuttle mission since the accident, scheduled for early 1988, will not carry Spartan as a secondary payload as planned. Spartan is a self-contained Goddard payload deployed from the shuttle bay to gather data for 40 hr.

Conservation in a recovery program is understandable, but can be overcome, he said. "We don't need to go back to the first shuttle launch to prove all our capability over again," Hinners said. The user community will be pushing "in a responsible way" to use the shuttle's capability to the fullest, he said. []

Lengthy Manned Mars Trip Envisioned

Reno, Nev.—A scenario for a manned Mars mission that envisions an extended trip time in return for sharply reduced fuel requirements was described here recently.

The concept, which uses a powered flyby, also envisions that the landers be fueled for the return trip by propellant produced from the planet's atmosphere. The scenario, product of two "Case for Mars" conferences designed to reawaken interest in exploring the planet, was presented to the AIAA meeting here.

The concept's main departure from earlier approaches is that it envisions crewmen descending in landing vehicles from the interplanetary transport vehicle as it flies past Mars rather than after it has gone into orbit around the planet. A short engine burn then would propel the now-unmanned vehicle onto a return trajectory that requires at least 18 months and possibly up to 30 months. A second crew would be launched two years after the first, and the first crew would perform a rendezvous with that vehicle as it swings by Mars for the long return flight. This sequence would be performed at every Mars launch opportunity—about every two years.

This profile means that total mission time for each crew would be at least four years, and possibly more, compared with about 34 months using a Mars-orbiting scenario. The advantage, according to James R. French, vice president of the American Rocket Co., is that the return flight requires little fuel, while considerable propellant is needed to move in and out of Mars orbit.

French, formerly a planetary scientist at Jet Propulsion Laboratory, said the crew shuttles would be fueled with carbon monoxide and oxygen. While this combination produces an extremely low specific impulse compared with conventional propellants, it could be extracted from the Martian atmosphere, which is 95% carbon dioxide. This fuel then could be used when the crew leaves the Martian surface to rendezvous with the interplanetary spacecraft for the return journey.

Primary hardware involved is the interplanetary spacecraft, propelled by a trans-Marian injection stage and carrying a crew shuttle. Three spacecraft capable of carrying 5-10 persons would be joined after launch from low Earth orbit, and the assembly would be spun to provide artificial gravity.

Shuttle Booster Redesign, Tests Raise Schedule Delay Concerns

By Craig Covault

Washington—NASA is facing a difficult shuttle solid rocket booster test program that is already falling behind schedule at a time when the National Research Council is raising serious questions about the boosters that could delay the next flight until late 1988.

In contrast, the Soviet Union's space program this week is preparing to begin new operations on its 21-ton Mir space station and is already embarked on a 1987 campaign that will total nearly 100 unmanned launches, compared with only 10-15 for the U.S.

On Jan. 28, the first anniversary of the shuttle Challenger accident, NASA has ordered all of its personnel to observe 73 sec. of silence at 11:38 a. m. EST, marking the liftoff time and flight duration of Mission 51-L before the vehicle and crew were lost.

A new National Research Council report on the booster redesign and test effort is "devastating," a senior shuttle program manager told AVIATION WEEK & SPACE TECHNOLOGY.

Senior space shuttle managers said last week if they succeed in aggressively paced solid booster and main engine test programs, the February 1988 launch target is still within reach. Other experienced shuttle engineers said a more realistic outlook is for no attempted launch until at least mid to late 1988.

Other key managers, including program head Navy Adm. Richard H. Truly—who takes a conservative approach toward all flight safety issues—noted that the new Research Council report is an interim assessment and the test program must be given time to show results.

The Research Council booster oversight team is concerned about the overall coherence of the test program, however. "It is difficult to relate the objectives of each of the numerous tests to specific design requirements," the review committee said.

Nozzle Joint Section

The new report raises serious questions about the adequacy of the booster test program for the nozzle joint section of the Thiolok solid rocket booster. It recommends that at least five full-scale motor firings be conducted before the program returns to flight, as opposed to four in the NASA plan.

If NASA follows the Research Council recommendation, test spicing alone would allow first launch no earlier than spring, 1988, Truly said. NASA Marshall Space Flight Center director J. R. Thompson be-

lieves, however, that NASA must obtain booster test experience before it can decide whether to follow the specific Research Council recommendation that would slip the schedule. Thompson advocates an aggressive testing program. Other managers in the shuttle office and NASA said privately they do not see how NASA can reject the Research Council recommendations.

Additional issues with test, schedule or redesign implications were raised by the council.

"Only if the verification program goes very well can NASA's schedule be met," committee chairman H. Guyford Stever told NASA Administrator James C. Fletcher.

Expected Results

"The schedule for the program reflects an assumption that each test will produce results that are expected and understood; there is little room in the schedule for modifying the design if this does not prove to be the case. Preliminary tests have already produced results that were not anticipated," the panel found.

"The O-ring materials with better low temperature resilience were found to deteriorate when tested after extended exposure to the rust-inhibiting grease," Stever said. That finding resulted in NASA re-

turning to the same O-ring materials used with Challenger, but these would be equipped with heaters. The agency continues to work on new materials, however.

"The panel currently perceives that uncertainties in the design, and hence risk to the program, are now greater in the area of case-to-nozzle joint and for the other aspects of the nozzle than in the field joints. Several of the critical questions on the nozzle design can only really be answered with full-scale, full-duration testing," Stever said. This is one reason the extra test is recommended.

A senior shuttle engineer said that the modifications to the nozzle joint have introduced much complexity and potential for stress, and that it might have been better to concentrate on insulation designs to protect the old nozzle joint, rather than adding modifications. The Research Council had a similar concern.

"There is no real alternative in the program for the baseline design of the case-to-nozzle joint, which incorporates a large number of new bolts and bolt holes, hence complex stress patterns and potential leak paths," Stever said.

"We consider the lack of an alternative to be serious, since the joint is critical for safety. Few tests of the final configuration are planned," and those that are planned occur late in the test program, Stever told

Shuttle Emphasis Reduced as Users Turn to Expendable Boosters

Colorado Springs, Colo.—Changes to military and civilian space plans in the year since the shuttle Challenger accident have eliminated the shuttle as the focal point of the U.S. space program and resulted in the revival of the U.S. expendable launch vehicle industry.

Space users at the third annual U.S. Space Foundation conference here last week praised NASA's shuttle recovery effort and called the vehicle a technological marvel. However, they were quick to add that the shuttle alone is inadequate to serve their future needs without the help of unmanned launchers—either Titans, the new medium launch vehicle Delta or the future heavy lift launch vehicle.

The amount of attention now being paid by space users to expendable launchers easily rivals that of the shuttle. NASA projections of future shuttle launches, 23 Titan 4s and 13 Titan 2s. "They are dates and flight rates were called into question by one former NASA official, Donald K. "Duke" Staiton, who formerly headed the astronaut office at Johnson Space Center, predicted that NASA would not meet its targeted launch date of Feb. 1988, nor would it meet predicted launch rates in the first year or first five years. Staiton also predicted that the shuttle fleet will be grounded again in the future, and he said he believed there is a low probability that Vandenberg AFB will ever be used for shuttle launches.

Air Force Secretary Edward C. Aldridge said the Air Force will remove more of its satellites from the shuttle manifest if necessary because the satellites outweigh the shuttle's performance. He said he was sure the shuttle would be safer when it flies again, but it also will have lower performance and flight rates.

The Air Force has ordered 56 expendable launch vehicles for use in the next few years—20 medium launch vehicles, 23 Titan 4s and 13 Titan 2s. "They are only the beginning. We will buy many more," he said.

Fletcher. "We recommend that alternatives be established and special emphasis be placed on early, meaningful tests of the design."

Another problem the Research Council has found is in the prelaunch and launch loads the solid boosters receive in connection with the external tank, and how these can be accounted for in ground tests. The latter was a key concern of the Rogers commission report on the Challenger accident and a lingering concern among Thiolok managers.

"Significant changes in estimates of loads in the booster and both of its interfaces with the external tank have recently been reported to us," Stever said. The panel recommended the stress analysis for the boosters be reviewed and calculated again if necessary.

A new test stand at Thiokol designed to apply those loads on only one full-scale firing test before first flight also raised concern.

"The new facility may be limited in its capability to simulate these loads," the panel found. "We are concerned about how well the loads are understood and the adequacy of the new facility," Stever told Fletcher.

Additional Factors

Shuttle managers last week also cited new factors in the program:

- **Delays**—First test firing of a booster incorporating all of the required modifications has slipped by six weeks to late July. The first test firing since the accident using similar hardware as in Mission 51-L, but with some internal insulation modifications, remains about five weeks behind schedule.

- **Air skirt redesign**—A United Technologies/United Space Boosters solid rocket booster air skirt, the main load-bearing structure for the total vehicle on the pad through ignition, failed a ground test. "The test simulated the effects of the 'twang' vehicle motion at main engine ignition and caused a 1.5-ft. crack in the joint," Thompson said. The failure indicates a miscalculation of the relationship between twang loads and skirt design and will result in a redesign of the skirt before resumption of flights.

- **Flight readiness**—Truly last week directed study of a flight readiness static firing of the three Rocketdyne shuttle main engines with Discovery on the pad at Kennedy Space Center before first flight. That option, if exercised, would ship first launch to no earlier than the spring of 1988, under the best of circumstances. Such a test would reverberate Discovery's li-

and propellant system and help shuttle launch team capability after a long flight performance on some vehicle points, a tradeoff that will be assessed. No decision has been made, although Kennedy contractor documentation a Discovery static firing for Feb. 1988—the launch target date.

- **Crew escape**—Truly has approved a shuttle orbiter hatch jettison system and associated crew equipment such as a parachute and personal survival kit.

This would allow a crew bailout during medium-altitude flight, an unavailable before the accident. The is for implementation of the system time for the next mission, but any in the hatch jettison system would necessarily delay first flight. Truly Use of tractor rockets to ensure that members would clear the left wing not approved.

NASA will continue to study a rocket system. Truly decided against implementation of the tractor rockets engineers understand the risks and fits. Truly and other shuttle astronauts concerned about the potential for harm, since multiple rockets were stored in the middeck during year shuttle use. He hopes wind tunnel tests for guiding crewmembers away from the wing at the moment of bailout.

- **Additional tests**—Marshall Flight Center will recommend that ground-test solid rocket motors be cured and fired every year after the

sumption of shuttle flights to system performance and research—admittedly noted in flight hardware.

- **Kennedy contractor review**—has ordered a review of the adequacy of the shuttle processing contract at Kennedy, currently managed by Lockheed. The shuttle processing contract at Kennedy, currently managed by Lockheed. The shuttle processing contract at Kennedy, currently managed by Lockheed. The shuttle processing contract at Kennedy, currently managed by Lockheed.

- **Main engine progress**—Greatly increased firing tests of the Rocketdyne shuttle main engines have shown excellent results. No significant new problems have been discovered above those already assessed, such as hardware life-cycle and turbine blade and bearing wear items. Since December, the engines have been fired more than 14 times, equating to at least six launches. Main engine Discovery's flight are due at Kennedy in October, and the test program is on schedule to support that target. □

USAF Prepares Program to Procure Heavy-Lift Vehicles

Los Angeles—The Air Force is in the final stages of preparation for a heavy-lift vehicle (HLV) procurement program pending a supplemental Defense Dept. request for funds to study the concept. Plans are scheduled to be completed next month.

The new booster would be used primarily to launch Strategic Defense Initiative payloads.

The supplemental Defense Dept. budget request for Fiscal 1987 includes \$110 million for research and development of a new heavy-lift vehicle for SDI. Initial funding would be used to evaluate booster technologies capable of launching payloads weighing 100,000-150,000 lb. The program would begin with system definition and probably would include parallel contractor studies.

Initial HLV booster envisioned would be an unmanned system, which ultimately would have some components that could be recovered—but probably not for initial vehicles in the 1993 time period.

Capability to recover components such as the engines and avionics could be phased into the program later.

The Air Force is studying use of the space shuttle launch site at Vandenberg AFB, Calif., as a launch pad for an HLV booster, as well as evaluating other options such as constructing a new facility.

The \$3.2-billion shuttle launch site at Vandenberg had been developed and checked out in preparation for shuttle operations, although work is still being conducted on the main engine exhaust duct to prevent possible detonation of gaseous hydrogen following a launch abort. The Air Force plans to complete design of a steam inerting system to neutralize free hydrogen by December.

The Air Force would like to begin HLV operations in about 1993.

Lt. Col. L. Durocher, chief of advanced systems development division at USAF's Space Div., said a heavy-lift vehicle program probably would have to use propulsion systems that are available today because of the lead time required to develop new engines.

However, there could be improvements in the way in which tanks and other structures are produced and processed on the ground to minimize vehicle and launch costs, Durocher said.

A heavy-lift vehicle could be launched from either the West or the East Coast, although Air Force officials said Vandenberg would be more suitable if Space Launch Complex-6 is determined to be feasible for unmanned, heavy-lift launches.

Congress Balks at Proposal to Speed Space-Based Antimissile Defense

By Paul Mann

Washington—Scientists and legislators objected last week to any Defense Dept. attempt at early deployment of an antimissile defense network consisting entirely of thousands of kinetic kill vehicles—projectiles to destroy enemy missiles in high-speed collisions.

Congressional critics put the Administration on notice that attempts to channel funding away from long-term beam weapons to near-term kinetic kill technologies would invite the legislature to strip the Strategic Defense Initiative Organization of internal freedom to allocate its funds.

This threat accompanied disclosure by Senate officials that the SDIO has decided in principle to refocus research on kinetic kill technologies as the central element of an early deployment configuration.

"But they're not even far enough along with kinetic kill to talk about an architecture" for partial defense, Sen. J. Bennett Johnston (D-La.), a member of the Senate Appropriations defense subcommittee, said. "They're far enough along to say, 'We want more money for these kinetic-

kill type technologies.' ... Johnston said the prospective shift from beam to kinetic also is fueled by hopes at SDIO of galvanizing political support in Congress for the Fiscal 1987 SDI supplemental request and recovering a share of the annual reductions in SDI funding Congress has imposed in the past several years (AWST Jan. 5, p. 21). Those hopes appear likely to go unrealized.

Majority Opposition

In both houses of Congress last week, key-majority Democrats charged with military oversight said they would fight any Administration attempt at making a definitive decision this year on an early antimissile defense. This was a reaction to the timetable contained in the proposal for early kinetic kill deployment tabled by the George C. Marshall Institute, a pro-SDI public policy group here.

A panel of Marshall analysts theorized last December that deployment of a triple-layer defense, including boost, midlayer and terminal phases and consisting entirely of kinetic kill vehicles, could begin in 1994 if the decision to go ahead were

made in 1987, assuming streamlined management and procurement (AWST Jan. 19, p. 22).

Adm. William J. Crowe, Jr., chairman of the Joint Chiefs of Staff, said in congressional testimony last week that early deployment of SDI still required study. He said, "It will be quite sometime before we can make a recommendation" as to a timetable for phased deployment. Asked if that meant some time this year, he demurred, then said the decision possibly might come in 1988.

"You have to figure out the whole system before you start early deployment," Crowe testified. He agreed with the supposition that early deployment would compound Soviet military uncertainty.

But congressional Democrats accused the Administration of using the Marshall proposal as a disguise for what they alleged was a political scheme to entrench the SDI program in the nation's economy, so that its continuation would be assured after President Reagan leaves office in January, 1989.

"The Administration realizes SDI is losing favor," Rep. Charles E. Bennett

Abrahamson Asks Contractors to Gear Up For Mass Production of SDI Components

By Theresa M. Foley

Colorado Springs, Colo.—Aerospace contractors must gear up to begin mass production of hundreds of satellites that will be needed for the Strategic Defense Initiative, according to USAF Lt. Gen. James A. Abrahamson, who heads the program.

Abrahamson said last week that companies must begin using modular satellite designs and mass-production techniques to make affordable the hundreds of satellites that SDI will require.

Industry officials said he may have been referring to space-based kinetic kill vehicle satellites that an early SDI system might employ.

"We will begin to build satellites not as something built one at a time, tailored to very limited budgets and modified if you build two, but [designed] in terms of [manufacturing] hundreds," Abrahamson told the third annual conference of the U.S. Space Foundation.

SDI also is encouraging companies to develop low-cost mass production techniques for small components such as sensors and computers, Abrahamson

said today's early warning satellites use hundreds of sensor elements each, while SDI's warning satellites will require millions. Mass production of sensors and improved reliability are essential to reducing their cost.

Although Abrahamson is urging industry to prepare for such mass production, he said a deployment decision has not yet been reached.

"We are thinking through reasonable levels of how such a deployment would start. The time frame [for deployment] depends upon funding, how successful the research is and what level of effectiveness is appropriate to start. It also depends upon the threat," Abrahamson said.

A decision on how or when to deploy the first phase of SDI will be "made in the future at an appropriate level," he said. Defense Secretary Caspar W. Weinberger said two weeks ago the program should go forward as soon as it is ready, according to Abrahamson. "We are not there yet, but we are getting ready fast," he said.

Abrahamson said the program has not reached the point where the President could certify that it will cost less than Soviet countermeasures, a requirement Congress passed into law in 1985. He questioned the

certification requirement, saying that it must be made more specific. He also pointed out that other military programs, such as ships, tanks, and aircraft, are not subject to that criterion.

Abrahamson discounted cost objections to SDI. He said opponents "seemed to think there is some type of generic SDI architecture" to which costs can be assigned. Abrahamson has appointed two working groups to develop methods for making SDI cost projections.

Early Flight Stages

In endorsing deployment of the first phase of SDI, Weinberger was not calling for a terminal defense system, Abrahamson said. Instead, the early SDI system would be aimed at destroying Soviet missiles in the early stage of flight, at a point when it could not be determined whether the missile was targeted at a city or military installation.

If the layered defense mapped out the Soviet missiles early enough, it would be protecting both people and military installations, he said.

If early deployment of a "Phase-1" space-based SDI system is approved, the heavy-lift launch vehicle would be needed to boost hun-

The Force Prevails

Star Wars

(D-Fla.), a senior, pro-military member of the House Armed Services Committee, said. "They want to pump enough money into the program to institutionalize it before they leave office. They hope that if they get enough defense contractors in enough states hooked on the program, Congress could never undo it."

Johnston, also an SDI critic, pointed to Attorney General Edwin Meese, Jr.'s repeated statement at a recent private gathering that President Reagan should act quickly to deploy the first stage of SDI, "So it will be in place and not tampered

Martin Marietta has dubbed its new space pointing and tracking facility in Denver "R2P2," for Rapid Retargeting Precision Pointing. "I can't believe they did that," Lt. Gen. James A. Abrahamson, head of the SDI program, said. He has been trying for years to bury the "Star Wars" label attached to SDI. "We can't get rid of it," Abrahamson said, "it sticks."

WASHINGTON

STAFF

Successful early deployment of one Strategic Defense Initiative system already has been accomplished on budget but without congressional approval. Screen Prints, Inc., New Orleans, La., is manufacturing a line of SDI soft- and hardware—including T-shirts, a golf shirt, lined nylon jacket, baseball cap and coffee mug. All are adorned with two-color SDI orbiting shield logo. The company reports the majority of contracting activity to date has come from Huntsville, Ala., Colorado Springs, Colo., and Washington, D.C. Best-selling item has been the SDI sweatshirt—to protect against a cold reception from critics.

WASHINGTON

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with by future Administrations. ... Johnston warned the Administration that although prospects are excellent in Congress for long-term, robust research into antimissile defense, "the prospect for early SDI deployment is nil." If the President tries to divert funds from advanced beam technologies to less sophisticated kinetic kill systems, Congress will strip the SDIO of its freedom to allocate funding as it sees fit, Johnston said.

In the scientific community, the Union of Concerned Scientists, a nonprofit advocacy group and longtime critic of SDI, protested that the Marshall Institute's broad reliance on kinetic kill systems was doomed to failure. In a statement to the press last week, the union joined Johnston in emphasizing kinetic kill vehicles' reputations as fast-burn rockets and mass dispersers of hundreds of thousands of decoys.

The resurgence of the SDI debate began earlier this month when Defense Secretary Caspar W. Weinberger provisionally endorsed "phase one" deployment as soon as possible. His latest thinking, which he revealed during a Senate committee hearing, was said to have been influenced by that of the Marshall Institute. The secretary related his position in subsequent testimony last week before the House Budget Committee.

At the same time, USAF Lt. Gen. James A. Abrahamson, director of the Strategic Defense Initiative, said Weinberger's testimony did not constitute a decision to deploy, but rather portended a bid for faster research, aimed at earlier judgments as to the advisability of near-term deployment.

Senate aides informed by the General Accounting Office of the contents of a current secret Abrahamson briefing on SDI said it appeared that with respect to funding levels, there had been movement "programmatically" in the SDI organization toward early deployment.

Request for Research

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"The SDIO program appears to be changing as a result of discussion of early deployment," one aide said. "It appears that those are trial balloons for what they're [SDIO] considering."

"Trial balloons" refers to other elements of the Marshall proposal, including Lockheed's ERIS, a ground-based, heat-seeking kinetic kill technology recommended for midcourse interception of enemy warheads at altitudes of about 60 mi.

The third element, terminal defense, would be executed by the IIED heat-seeking missile, which would intercept warheads at relatively low altitudes.

"What we discovered in our [GAO] briefings," the aide said, is that SDIO "at a project level—below the [budget] program level—was moving money around to optimize research for a near-term deployment" for space-based kinetic kill vehicles and related technologies.

Regarding the uncertainty about the form of an early deployment system, another aide explained, "If all we had were calls for near-term deployment and the program didn't change at all, then we've just got rhetoric. But the briefings we had indicated that the program is changing at the top [at the Abrahamson level] as a result of consideration of this near-term deployment idea. ... It's very clear that if you want to do a near-term deployment you don't have many options," scientific ally, except kinetic kill and related technologies. This was the conclusion of the Marshall Institute.

John E. Krings, the Defense Dept.'s director for operational test and evaluation, told AVIATION WEEK & SPACE TECHNOLOGY last week that recent SDI tests and experiments had led to the conclusion that there are elements that could be fielded "much earlier than we thought." He said the research showed that technology and equipment associated with terrestrial weapons could be adapted for use in space basing.

Krings cited the Hughes Phacusa air-to-

USAF Awards McDonnell Douglas Contract to Build, Operate MLVs

By Bruce A. Smith

Los Angeles—The Air Force has selected McDonnell Douglas to develop, produce and operate the medium launch vehicle (MLV) in a contract award that represents a critical step in recovery of U.S. military and commercial launch capabilities following loss of the space shuttle Challenger one year ago.

McDonnell Douglas Astronautics Co. last week received the second phase of the MLV contract for \$316 million from Air Force Space Div. to build seven boosters to launch Navstar global positioning system (GPS) satellites, with options for 13 additional MLV boosters. Primary objective of the MLV program is to rapidly deploy the Navstar constellation of satellites, but the booster program also is intended to provide launch capacity for commercial spacecraft as well as other Defense Dept. payloads.

The Air Force considers build-up of the 18 operational Navstar spacecraft and three on-orbit spares one of the highest payload priorities following the Challenger disaster. Navstar—a worldwide navigation system for use by all military services—originally was to be placed in orbit using the space shuttle by 1989.

Prior to the shuttle accident, the first production Navstar satellite was to be launched this month. The present schedule calls for initial launch on the first MLV in October, 1988.

The McDonnell Douglas total fixed price incentive contract, including the basic program and options, is valued at \$689 million, with an additional \$60 million to be awarded as performance incentives for the 20 MLV missions at the rate of \$3 million per launch. In addition, there is a potential award fee of \$1 million per year for five years.

The contract includes the production, testing, integration, launch support, launch pad activities and actual launch operations. Initial MLV launch capability is scheduled for the single launch in 1988, six in 1989, seven in 1990 and six in 1991.

Minimum Air Force requirement was for four launches per year beginning in 1989. The 10 prototype Navstar satellites previously were launched by Atlas boosters from Vandenberg AFB, Calif.

Major factors that played a part in selection of the Delta MLV over the General Dynamics Atlas/Conquest and the Martin Marietta Titan 34D were the Delta success rate of 97.7% in 45 launches during the past nine years and the cost of the Delta program. In addition, the Delta

vehicle has demonstrated it can provide 12 launches per year, which would make available five or more launches per year to commercial customers.

Lt. Gen. Bernard Randolph, USAF deputy chief of staff for research, development and acquisition, said the ability of the Delta vehicle to attract commercial launch business was a key factor in the decision to award the contract to McDonnell Douglas.

Commercial Orders

Astronautics has four firm orders with commercial satellite owners for Delta vehicles—two from Comsat Corp. and one from American Satellite Co. and International Maritime Satellite Organization. Louis C. Raburn, director of Delta programs at McDonnell Douglas Astronautics in Huntington Beach, said under the MLV contract Astronautics will be responsible for all phases of the program—from production and commercial market-

ing to launch operations. The Delta program previously was conducted by McDonnell Douglas under contract with the National Aeronautics and Space Administration, with associate contractors for major booster systems such as main engines and solid rocket motors. NASA was the agency through which commercial users contracted for launch services.

Astronautics started the Delta production line in November and has about 1,200 persons working on Delta at various McDonnell Douglas facilities. Plans call for gradually increasing the workforce by 400-500 persons. Most fabrication, engineering, development work and management of the program will be conducted at Huntington Beach, with final assembly of the MLV boosters to be done at a new plant in Pueblo, Colo.

Astronautics plans to begin operations in the \$1.7-million Colorado facility this year, building up to about 200 employees by early next year. Delta stages will be

transported directly from Pueblo to Cape Canaveral, Fla., for launches. There are no plans for launching MLVs from Vandenberg AFB, Calif.

First production Navstar satellite is scheduled to complete final testing next month at Rockwell International facilities in Seal Beach, Calif. Rockwell's Satellite Systems Div. has a contract to build 28 Navstar spacecraft.

James R. Eymann, vice president of navigation and environmental sensing systems at Satellite Systems Div., said three spacecraft have been completed and 13 are in various stages of assembly, integration or checkout at Seal Beach.

Rockwell expects to complete work on four spacecraft this year and another five during 1988, which could result in a backlog of eight to nine satellites by the first MLV launch.

Studies continue on where to store the satellites until they are ready to be launched. Locations that have been considered include Rockwell, Navstar processing facilities in Florida Vandenberg AFB.

Reentry Vehicle Test

Los Angeles—A modified Minuteman 1 missile was destroyed by range safety officers shortly after launch from Vandenberg AFB, Calif., Jan. 20 during a research and development flight to evaluate reentry vehicles.

The 22-year-old missile—destroyed about 3 min. after launch from Vandenberg at 12:35 a.m. PST—was carrying three experimental reentry vehicle designs as part of the severe environment nosetip test (SENT) program.

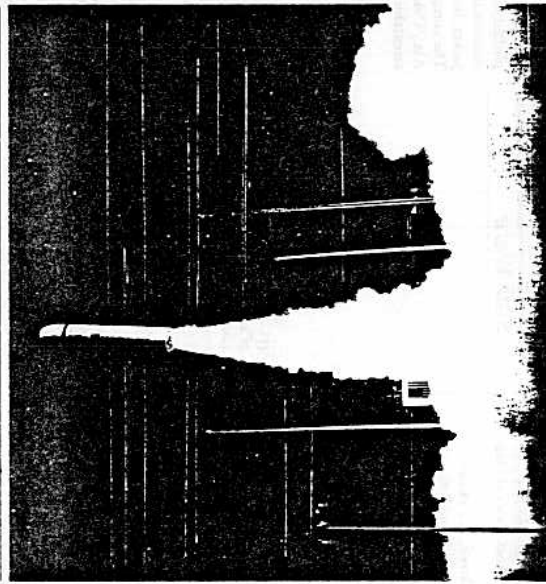
The program is conducted by the advanced strategic missiles system organization at USAF's Ballistic Missile Office (BMO) at Norton AFB, Calif.

The booster was destroyed during firing of the third stage when a malfunction caused deviation of the missile from its planned flight path. An investigation is under way to determine the cause of the problem. Debris from the missile landed in the ocean 100-150 mi. east of Midway Island.

This flight was the first in a series of three research and development launches in the \$25-million SENT program, which is designed to demonstrate reentry vehicle performance at extremely high atmospheric pressures during reentry.

The reentry vehicles were intended to impact the missile range at a velocity of 20,000 ft./sec.

Navy Flight Tests Trident 2 Missile



First Navy/Lockheed Missiles and Space Co. Trident 2 D-5 ballistics missile lifts off newly constructed Pad 46 at Cape Canaveral Jan. 15 (awast Jan. 19, p. 29). As many as 25 pad and 10 submerged submarine launches are planned in the development flight test program for the Trident 2.

air missile and the Hughes Maverick air-to-surface missile, both of which supplied technology to SDI's Delta rocket experiment Sept. 5. In that exercise, one SDI vehicle homed in on and intercepted a second SDI vehicle (awast Sept. 15, 1986, p. 19).

Objections to early deployment run the gamut. They include:

- **Legal constraints**—According to Sen. William Proxmire (D-Wis.), a member of the Senate Appropriations defense subcommittee, early deployment would break a 1985 law that prohibits deployment of SDI systems, in whole or in part, unless the President can certify to Congress that deployment will be cheaper than Soviet countermeasures. Nor can deployment proceed upon certification unless both houses of Congress so consent by majority vote. Abrahamson responded that costs will hinge on the evolution of the threat and on research findings. He has started a search, however, for new methods of SDI cost projection.

- **Cost**—Proxmire, citing cost estimates in congressional testimony by past secretaries of Defense, said full deployment geared to population defense will cost about \$1 trillion. Furthermore, operational, maintenance and modernization costs of SDI were estimated at \$100-200 billion "each and every year in perpetuity" by former Secretary of Defense Harold Brown. But the Marshall Institute estimated costs of an initial kinetic weapons defense at \$54 billion. It put the costs of a full three-layer network—confined to kinetic weapons—at \$121 billion.

- **Disagreements about security value**—Proxmire charged that strategic defense would provide no additional protection either to the 50% of U.S. nuclear weapons deployed on submarines or to the 25% deployed on bombers. The remaining 25% deployed on strategic land-based missiles could be switched to mobile basing at far less expense than building SDI systems, he said. He said strategic defense made more sense for the Soviet Union than the U.S. because the Soviets have deployed 70% of their deterrent on stationary, land-based missiles. Proxmire also said that SDIO has not begun to solve the technological problems involved in lifting the millions of pounds of hardware into space and into the proper orbit.

- **Effectiveness**—Proxmire challenged Marshall estimates that ultimately SDI would be able to defend U.S. cities by intercepting 90-99% of Soviet warheads. "The Marshall panel offers no documentation to support this assertion," he said, but even if it were accurate, "the National Academy of Sciences has estimated that if only 1% of the Russian arsenal should strike American cities, this country would suffer the death of between 35 and 55 million Americans, in an unprecedented and crushing calamity." □

sidered include Rockwell, Navstar processing facilities in Florida Vandenberg AFB.

Eymann said that despite launch delays the company has continued to pursue the production program at the subsystem level, but has slowed down the pace of assembly and testing to match new launch projections.

Deliveries from subcontractors are 75% complete, and about half of Rockwell's suppliers have completed delivery for the 28 satellites. Purpose of the program is to accumulate hardware at all levels of production and assembly to minimize the number of satellites that have to be placed in storage.

Restructuring Study

Rockwell had planned to produce star spacecraft at an average rate of one per year. Rockwell is studying the restructuring of the program to stretch out production and final test about three years with a rate of about six per year.

The first nine spacecraft—designated Black-2A satellites—will be launched on a modified Delta 3920 payload assist vehicle (PAM-D) launcher with upgraded Castor-4A strap-on motors using a slightly higher pressure. The changes would have a larger firing with a section diameter increased to 9.3 ft. to accommodate the Navstar.

Satellites 10 through 28 will be a 200 lb. heavier because of the addition of a nuclear detonation sensor system, will require additional modifications to the launch vehicle. The changes include use of graphite epoxy solid rocket motor cases, a 4.7-ft. extension of the first fuel tank and a 7.3-ft. extension of oxidizer tank. The stage will continue to use the Rockwell RS-27 engine.

The two-phase MLV program began with six-month research and development contract awards to McDonnell Douglas General Dynamics, Martin Marietta, Hughes Aircraft Co./Boeing Aerospace, which later was eliminated from competition. The Air Force required

total launch capability of no later than early 1989, with a minimum launch of four satellites per year for five years. Scheduled launch availability of not less than 95% was specified.

General Dynamics proposed a version of the Atlas/Conquest with minor modifications, while Martin Marietta proposed a version of the Titan 34D booster. Hughes and Boeing proposed a booster based on structural elements of the space shuttle

Former SDI Scientist Believes Gains In Defensive Capabilities Could Achieve Limited Nuclear Attack Protection

Philadelphia—Continuing achievements in critical defensive technologies could result in cost-effective protection of specific areas of assets against a limited nuclear threat in 10-15 years.

Gerold Yonias, vice-president of the Titan Corp., San Diego, Calif., and former chief scientist at the Strategic Defense Initiative Organization, told attendees of a World Affairs Council of Philadelphia conference here on strategic defense and American security that:

- Defending hardened, mobile, decoy-based targets against a limited number of attacking missiles at a cost of several tens of billions of dollars if deployment begins in about 10 years.

- Defending soft targets such as large areas of the U.S. against accidental launches of nuclear armed ballistic missiles or against countries with very limited offensive nuclear capabilities. This type of defense also would be required as insurance against possible Soviet cheating if the U.S. and USSR were to agree to the elimination of nuclear-armed ballistic missiles. Cost of this type of system is estimated to be \$100 billion if deployment is initiated in about 10 years.

- Defending limited areas and assets against an all-out nuclear attack. This type of defensive system would offer protection to unspecified areas and introduce sufficient uncertainty into an enemy's plans to deter an attack. Cost to achieve this type of capability is estimated to exceed \$100 billion if deployment is initiated in about 15 years.

However, the primary obstacle to the successful development of a defensive sys-

tem is "funding eliaos," Yonias said. "If you plan to run a program at \$3.8 billion and go along for a month or so and then the budget comes out at \$2.7 billion, there are many programs that have started, money has been invested by industry, programs have to stop and start up again, and people have to be shifted. There's an enormous amount of inefficiency and waste in this type of situation."

Understanding the threat posed by the Soviets and their potential countermeasures is another obstacle that must be overcome. "We don't understand the Soviets and it's difficult for us to think the way they do," Yonias said.

Flexible Response

The space mine, fast burn boosters and anti-simulation techniques must be developed and tested by the U.S. to establish a strategic defensive system that can respond rapidly and flexibly to deployment of any countermeasure, he said.

The U.S. also must overcome the cult of the offensive. "The U.S. has built its strategic capabilities on offense. We don't have the institutions, experience and techniques to think defense," as the Soviets do, he said.

Since the Soviets have an operational antiballistic missile system, they are constantly training people to think defensively. The Soviets also have a baseline system that they can modify, reducing the time it would take them to bring new developments to operational status. If the U.S. decides to deploy a strategic defense system, it could take five to seven years.

"Not being in the business means that there are inevitable delays," Yonias said. □

Congressmen Charge White House With Space Policy Failures

Washington—White House Science Adviser William R. Graham came under fire last week from members of the House Science, Space and Technology Committee, who charged during a hearing that the Reagan Administration does not have a national space policy and has failed to coordinate space activities among sponsoring agencies.

Rep. Robert A. Roe (D-N.J.), committee chairman, said the Administration should develop a plan that ties together interrelated space projects, such as the space shuttle, space station and Strategic Defense Initiative. Rep. Robert Walker (R-Pa.) told Graham, "We need some

leadership. I don't see that happening." Walker said the U.S. space strategy is currently defined in terms of projects, instead of policy. Graham said the Administration "may have been remiss" in clearly spelling out the national space strategy, but that it does exist in a general framework. Rep. Bill Nelson (D-Fla.) criticized the Administration for dropping several space items out of the Fiscal 1988 budget, including the Advanced Communications Technology Satellite and the Navy Remote Ocean Sensing Satellite. Nelson, who was reelected last week to the chairmanship of the House space science and

NASA Managers Fear Loss Of Space Program Leadership

By Craig Covault

Washington—National Aeronautics and Space Administration managers believe the agency's ability to lead the U.S. space program is being eroded because the White House is allowing other federal agencies, most of which are only peripherally involved in space activities, to influence key decisions.

The Administration and other agencies, however, disagree. "Space is being normalized and that means broadening the players. NASA is upset because they see their empire being carved up and can do little to stop progress," one official said. The White House Senior Interagency Group for Space (SIG-Space) met late last week to decide on policies important to the Defense Dept. use of the space station—a meeting NASA managers believe could be pivotal to the agency's future space leadership role in the Reagan Administration.

The SIG-Space committee considered a new U.S. space station negotiating position that will ensure Strategic Defense Initiative or other U.S. military space research can be conducted on the station without interference from international agreements with Canada, Japan and the European Space Agency governing station participation. The review process leading up to the SIG meeting was intended to focus on the Defense/station issue. The process, however, turned instead into "an excuse by other federal agencies to exert their own policies" on U.S. space planning, a senior NASA manager said.

Reagan Administration officials disagree and said NASA must face reality. Applications subcommittee, told Graham that the Administration should purchase a Titan 4 to launch one of four planetary spacecraft that are crowded together on the shuttle manifest beginning in 1989. Graham responded that Titan 4 production is close to its limit during that time, which would mean that ordering another vehicle for NASA use may not be possible.

The space science subcommittee, which was organized last week for the new congressional session, will be larger than last year, with 15 Democrats and eight Republicans compared with nine and six, respectively, last year.

"It's time they come down with everyone else and be part of normal Administration staff operations," one official said. Treasury Secretary James A. Baker recently sent NASA Administrator James C. Fletcher a letter admonishing him for "excluding other executive branch departments" on a shuttle/SpaceLab matter that NASA believes is so routine a broad Administration review would be excessive. Agency officials cite the letter as an example of the problems they are facing.

Real Message

Baker was acting in his capacity as chief of the Economic Policy Council overseeing the Administration's commercial space working group. Several NASA officials told AVIATION WEEK & SPACE TECHNOLOGY they believe the real message in the Baker letter is that NASA's ability to make future U.S. space judgments will be seriously diluted.

The SIG-Space events cited by NASA officials are:

- **Defense station interest**—The Defense Dept. halted NASA's space station negotiations while they were at a critical phase with Europe, Japan and Canada in order to assure that the agreements would not preclude use of the station for national security research. Defense managers stressed that they need stronger language in the agreements to protect U.S. national security interests. NASA managers are concerned the new U.S. negotiating stance could force Europe, Japan and Canada to change their plans on participation. An ironic sidelight is that some international partners believed the slow progress of the station negotiations prior to the Defense move was caused in part because of a lack of high-level Administration involvement.

- **Technology transfer**—The Commerce Dept. became involved in the Defense Dept. review and raised station technology transfer issues that also could affect the course of NASA's negotiations.

- **Expendable boosters**—The Transportation, Commerce and Defense departments are all now involved in the assessment of expendable launch vehicle use and NASA's mixed-fleet studies. The Transportation and Commerce departments want to ensure their commercial launch vehicle policies are followed, while the Defense Dept. needs to ensure the mixed-fleet decisions will protect its interests. Transportation and Commerce last week raised new objections to the station plan at the SIG meeting, seeking guarantees that expendable boosters will be used for station logistics. Experienced U.S.

booster contractors have been angered because they find themselves dealing with some space commercialization officials with no background in satellites or launch vehicle operations.

Another problem has been a lack of action within the Transportation Dept. on following its own policy directives, officials said. New space booster management in the Transportation Dept. is expected to strengthen that agency's activities.

- **Heavy-lift booster**—The Defense Dept. and Strategic Defense Initiative Office neglected to inform or consult NASA on its decision to request more than \$500 million over the next two years to initiate the new U.S. heavy-lift booster program, which also has broad ramifications for civilian

Delta Contract Carries Stiff Financial Penalties

McDonnell Douglas Delta medium launch vehicle (MLV) is being developed for the Air Force primarily to launch the Navstar global positioning system constellation of satellites. McDonnell Douglas Astronautics Co. has received a contract to build seven MLVs with options for 13 additional boosters. Under the contract, which has stiff financial risks involved, if one of the 20 MLVs fails, the company will lose the entire \$60 million incentive package of \$3 million per launch. Two failures will result in loss of half the company's profits on the medium launcher contract, while three failures would mean loss of all Air Force profits.

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Commercial Delta 2 to Be Priced Lower Than International Competitors

By Theresa M. Foley

Washington—Commercial version of the McDonnell Douglas Delta 2 expendable launcher will be priced lower than the amounts currently charged for the European Ariane, Chinese Long March 3 or Soviet Proton, according to John Yardley, McDonnell Douglas Astronautics Co. president.

The Delta pricing structure should enable the U.S. to compete again for satellite launch business. The average price of each of the 20 Delta 2s purchased last month by the Air Force to launch the Navstar global positioning system satellites was \$33 million.

"We haven't dealt with commercial prices yet because we have to strike an agreement with the Air Force on our cost of using their facilities," Yardley said. However, if the facility use fee is modest, the commercial prices will be close to the Air Force prices, he said.

Satellite owners may find launch prices for Delta-class missions dropping as a result of the selection of Delta as USAF's

medium launch vehicle. Although Delta prices will be below those currently charged by ArianeSpace, China or the Soviet Union, "all three of them, if they want the business, will drop their prices," Yardley said. The USSR and China want the hard currency and are likely to lower their rates, Yardley predicted. However, ArianeSpace is less likely to go below its marginal price. Yardley said ArianeSpace has raised its rates 25% since the space shuttle accident. "If I understand it right, they could drop their prices 25%, and we'd still beat them," he said.

Availability Factors

The number of commercial Deltas that can be sold depends on whether satellites are designed within Delta's weight range and whether competitors drop their prices, Yardley said. McDonnell Douglas officials believe that, because of advances in technology, satellite sizes may start dropping from the very large designs, such as Intelsat 6, that have evolved during the last few years.

The Delta 2 program will be capable of

12-18 launches per year, of which 5-11 will be available for commercial customers. McDonnell Douglas will not be able to guarantee that commercial satellite users will not be bumped by military payloads if a launch failure disrupts the schedule. Satellite owners have expressed concern about purchasing expendable launchers that also are used by the Defense Dept. because they do not want to be bumped from the manifest, as many were following the Challenger accident (Awest Nov. 17, 1986, p. 18).

Although McDonnell Douglas does not have a commercial user policy on manifesting rights, Yardley said he did not believe joint use of Delta by the military and commercial sectors would create a problem. He pointed out that Delta has been able to recover from previous failures in about four months, much less time than other launchers, which causes minimal disruption to the schedule.

The new Delta will offer commercial satellite owners about 30% more lift capability than the Delta 3920, which could boost 2,800 lb. to geostationary transfer

"Shuttle-unique is defined by the capabilities of the market, and not the capabilities of the shuttle alone," Baker told Fletcher, although Baker failed to note it would be impossible to launch Spacelab on anything but the shuttle. "I believe [your] proposed review process should be broadened to include the Transportation Dept. and other agencies with significant interests in the implications of space launch decisions."

Baker also sent a copy of his letter to Elizabeth Hanford Dole, secretary of Transportation.

NASA managers are less concerned about the specific incident than the broader implications. They fear that instead of being given a basic set of Administration policy guidelines from which they can make their own decisions, the agency is facing micromanagement on all U.S. space decisions that will slow recovery from the Challenger accident and reduce the ability of the space program to move forward with minimum bureaucracy.

Administration officials disagree. They believe all of the issues are so nationally important they require broad assessment under Administration policies that place more space responsibility in agencies other than NASA. "NASA is now finding they have to join the real world," an Administration official said. □

■ **The Baker message**—Baker, who plays a key role in formulating Administration policy, reacted strongly when Fletcher sent him a courtesy letter notifying him of NASA's intent to book a third West German Spacelab mission on the shuttle.

"Since Spacelab is clearly a shuttle-unique payload, a shuttle launch is appropriate since it falls under a specific exception to the President's shuttle launch policy," Fletcher wrote Baker.

"Therefore, I plan to negotiate a reimbursable launch services agreement with the German government," he said. "NASA will make the determination of which proposed payloads are shuttle-unique and will be guided by the departments of Defense and State."

Baker's Response

Baker responded by telling Fletcher, "[Your] proposed process gives the appearance of excluding other executive branch departments and agencies with interests in the implications of payload determinations."

"Examples of these are national security agencies other than Defense, and the Transportation Dept., which has the responsibility for representing in the federal government, suppliers of private launch services."

■ **U.S. space operations**—"That was a preemptive strike by the Defense Dept.," a NASA official said. He noted the heavy-lift booster decision came while NASA and Defense are still conducting the national space transportation architecture studies designed to determine such future launch vehicle needs.

Air Force Secretary Edward C. Aldridge, Jr., said last week the technology booster project represents technology needs endorsed by NASA/Defense Dept. advanced launch vehicle studies started two years ago. The decision to initiate the new program "was done at the last minute and we did not have time to coordinate with NASA," he said. Other sources said even some senior Air Force space managers were not informed beforehand about the new booster initiative. Aldridge said he believes the new booster should use entirely new design concepts, not shuttle-derived technology as advocated by many in NASA. "We cannot use old approaches and get the launch costs down," he said.

■ **Congressional pressures**—NASA believes it also is being micromanaged by congressional committees. Managers cite earlier House Appropriations Subcommittee restrictions on space station funding until NASA included specific hardware such as power and laboratory elements desired by the subcommittee.

USAF Plans Launch of KH-11 Replacement

Washington—The U.S. Air Force plans to resume launch of Central Intelligence Agency/TRW KH-11 imaging reconnaissance satellites from Vandenberg AFB, Calif., this summer to relieve the pressure on the single KH-11 that has been operational since two Titan 340 boosters carrying reconnaissance payloads were lost at Vandenberg in mid-1985 and early 1986.

Requests for imagery from multiple U.S. military and intelligence agencies of Soviet and other hostile territory have been piling up at the National Reconnaissance Office since the loss of the earlier KH-11 and Big Bird satellites. Operation of the remaining KH-11 in orbit has been modified to provide pictures of the highest priority intelligence targets while conserving satellite life.

The Air Force will determine by next month whether inspections of United Technology Corp. Chemical Systems Div. Titan solid motors have identified enough motor segments without insulation debond problems to allow Titan launches to resume.

It is expected that the first mission flown will be a KH-11 launched into polar orbit from Vandenberg. However, a critical electronic intelligence satellite or missile early warning payload were to fail

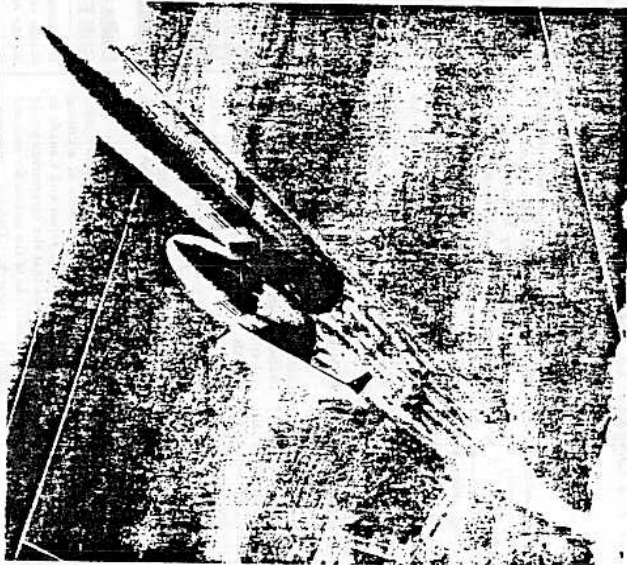
in geosynchronous orbit, a Cape Canaveral launch could be scheduled.

The Air Force has continued to delay Titan launches because inspection of previously manufactured solid motors showed debond problems like those that contributed to the Apr. 18 explosion at Vandenberg (Awest Apr. 28, 1986, p. 16).

Without referring to the Titan payloads, Air Force Secretary Edward C. Aldridge said last week that inspection of motor segments at Cape Canaveral and Vandenberg turned up debond problems "that could have caused similar accidents with Titan 340s downstream."

The Air Force is pulling together enough verified segments to build two complete Titan 340s to support critical launch needs at either Vandenberg or the Cape. Aldridge told the National Space Club that a new Titan 4 pad being built at Vandenberg will be capable of launching the vehicle with a Centaur upper stage.

The use of Centaur upper stage indicates extremely heavy intelligence payloads could be launched from Vandenberg by the Titan 4 starting about 1992. Titan 4 launches using an existing Vandenberg pad not equipped for Centaur can begin in 1990. Use of Titan/Centaur further reduces the requirement to initiate Vandenberg space shuttle missions.



General Dynamics Proposes Advanced Launcher Concept

Colorado Springs, Colo.—Two versions of General Dynamics' Advanced Launcher Vehicle are shown lifting off in these artists' concepts. The Advanced Launcher Vehicle (ALV) concept could boost payloads into orbit for less than \$600 per pound, according to the company. The basic ALV uses a 207-ft-tall cryogenic core vehicle and 3-12 solid rocket boosters (far left), according to John Gaines, General Dynamics marketing manager for advanced space transportation. The payload fairing for both vehicles is 26-ft in diameter, with variable length. The basic ALV is capable of boosting 25,000-100,000 lb. to low Earth orbit depending on the number of solid rockets used and could be available by 1992. For early launches, an expendable derivative of the shuttle main engine would be used in the core vehicle. But General Dynamics believes a new low-cost engine could be incorporated into the ALV by 1995-97. Gaines said the upgraded ALV, which uses a winged flyback booster (near left) as a first stage, could be ready by 1997. The flyback booster, which would be powered by liquid oxygen and hydrocarbons, would allow the ALV to lift 150,000 lb. to low Earth orbit. General Dynamics' officials believe the concept meets requirements of the heavy-lift launch vehicle. The ALV also meets future Defense Dept. and civil space needs, including space station and NASA interplanetary missions, Gaines said. Both versions could use existing shuttle launch facilities at Cape Canaveral, Fla., or Vandenberg AFB, Calif.

Rockwell Predicts HLV Will Lower Launch Costs

By Bruce A. Smith

Los Angeles—Rockwell International's heavy-lift vehicle (HLV)—a shuttle-derived design that includes a return glider with detachable payload carrier—has the potential to reduce launch costs by more than two-thirds over the price of the shuttle, according to Rockwell officials.

The Air Force, which plans to begin system definition studies of a heavy-lift booster pending approval of a supplemental request for \$110 million, has stressed the need for a new design rather than using existing components in order to meet service target costs for production and processing.

The initial Air Force objective is to cut costs by two-thirds, with an ultimate goal of launching payloads at one-tenth of the current price. Initial HLV launches could place about twice the maximum payload of the space shuttle in orbit, reducing costs by one-half. In addition, the unmanned glider—designed to return from orbit after satellite deployment—would have about half the major systems used in shuttle orbiters and require only half the time, and cost, for launch processing. The glider also would have two-thirds less thermal protection system surface area than an orbiter.

Rocco A. Petrone, president of Rockwell's Space Transportation Systems Division, said costs could be reduced further through improved production and processing techniques, while ongoing improvements to such shuttle systems as computers and inertial measurement units could increase tolerances and further reduce the time required for prelaunch checkout.

Rockwell officials added that if an initial launch capability is required in the early 1990s, there would be a limited

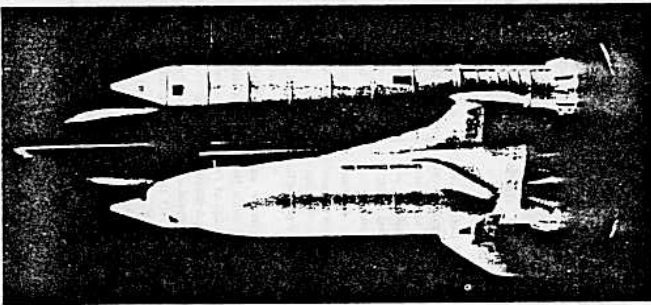
number of new components that could be developed in time. In addition, existing booster components could be used at current launch facilities with fewer modifications.

The partially reusable booster would be capable of placing up to 139,000 lb. in to a 150-naut.-mi., 28.5-deg.-inclination orbit from Kennedy Space Center. Internal dimensions of the payload container would be about 80 ft. in length—15 ft. longer than the shuttle cargo bay—while width would be about the same as an orbiter.

The container abroad would be removed once the launcher was outside the atmosphere, and the framework of the payload carrier would be ejected from the glider after the spacecraft had been deployed. In the event of an aborted mission, the payload could not be returned to Earth with the glider. The glider would weigh 80,000-90,000 lb., compared to the orbiter landing weight of about 220,000 lb.

The glider would be shaped to fit between a shuttle external tank and the payload carrier, with the same tank attachment points as an orbiter. The return vehicle could have up to three space shuttle main engines in the same location as an orbiter for ease of servicing at Kennedy Space Center or Vandenberg AFB, Calif.

The vehicle would have a reaction control system for stabilizing in orbit prior to payload deployment and vertical stabiliz-



ers on the tips of the smaller, higher-lift wings. Placement of the stabilizers on the wing tips would provide greater accessibility to the propulsion system, a longer payload carrier and less interference when mounting the carrier.

Rockwell officials said the return vehicle system could be developed for an initial capability of 1994 or 1995, if the launch rate was 12-15 per year, depending on the size of the payloads. The number of gliders would depend on the launch rate.

The company has developed an in-line vehicle for a launch capability in the early 1990s at a flight rate of 10 or fewer per year. The launcher would include a shuttle-derived external tank, with the payload placed on top and a single shuttle main engine on the aft end to meet a requirement of 100,000 lb. Two solid rocket motors would be attached to the tank to enable 100,000 to 107,000 lb. to reach a 150-naut.-mi. orbit from Kennedy Space Center.

Rockwell also is studying larger in-line heavy-lift designs as options to the side-mount configuration that would have a lengthened external tank, payloads mounted on top of the center tank section and shuttle main engines attached to the aft end of the structure.

British Designing Independent Sighting Satellite System

London—Britain is designing a signal intelligence satellite system, code named Project Zircon, using U.S. technology originally developed for spacecraft such as the Magnum sighting satellite launched in mid-January, 1985, by the shuttle on a secret military mission (Awaraz Feb. 4, 1985, p. 20; Jan. 7, 1985, p. 15).

Project Zircon is designed to give Britain an independent means of intercepting electronic message transmissions from Warsaw Pact nations. At present, Britain relies entirely on data passed from the U.S.'s electronic intelligence network.

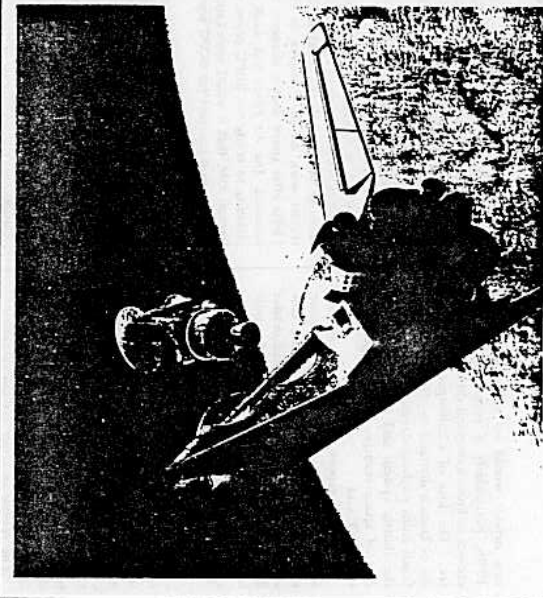
The satellite is being developed by British Aerospace and GEC Avionics with technology transfer from TRW. It was to have been launched under the cover story that it was an additional communications satellite to the two British Aerospace Skynet 4s already announced by the Ministry of Defense.

Disclosure of the satellite, which came as the result of the cancellation of a British Broadcasting Corp. television documentary on excessive secrecy in government, caused a major political controversy in Britain.

Zircon is planned for launch into a geostationary orbit at 53 deg. E. Long, which would put it approximately over the equator south of central Russia. □

Orbital Sciences Selected To Supply Upper Stage For ACTS Mission

NASA's Advanced Communications Technology Satellite and Transfer Orbit Stage are shown being deployed from the space shuttle in this artist's concept from Orbital Sciences Corp. OSC recently was selected by the space agency to supply a TOS upper stage for the ACTS mission, which is planned for launch in November, 1990, on the shuttle mission to retrieve the Long-Duration Exposure Facility. ACTS was cancelled in NASA's Fiscal 1988 budget request, but Congress is expected to restore money for the program, as it has done several times in the past when the Administration attempted to cancel it.



Space Station Faces Possible Two-Year Deployment Delay

By Theresa M. Foley

Washington—NASA officials said last week that space station deployment could be delayed up to two years due to the new \$13.145 billion cost estimate, while the Congressional Budget Office suggested cancelling the station and the replacement orbiter to cut the federal deficit.

The U.S. has lost its preeminence in manned space flight to the Soviet Union, NASA Administrator James C. Fletcher said last week. "I think we may have lost the competitive edge" to the Soviets in the

manned space program, Fletcher told the Senate Commerce subcommittee on science, technology and space. He also said the U.S. is lagging behind Europe, Japan and the Soviets in one field of space science, microgravity research.

Fletcher said the U.S. manned space station, whose deployment could help the U.S. catch up to the Soviets, is likely to be delayed to 1993-96, instead of 1994, because cost estimates have increased well over the \$8 billion previously budgeted for the program (AWST Jan. 19, p. 28). Fletcher, who would not provide details

Report Urges Shift in Microgravity Effort

Washington—The U.S. must make immediate changes in its microgravity science program or risk falling further behind Japan, Europe and the Soviet Union over the next 10 years, NASA Administrator James C. Fletcher was told recently in an interim report on the state of U.S. microgravity science.

Unless NASA devotes more resources to the program, the U.S. risks becoming "the landlords of the space station, not the tenants," because it will be unprepared to use the station in the 1990s, according to the study, which was chaired by astronaut and microgravity expert Bonnie Dunbar. The commitment of European and Japanese resources to materials processing in space is much greater than that of the U.S., and those nations will be in a much better competitive position to gain economically from microgravity science in the future, the Dunbar study warned.

West Germany is spending an estimated \$200 million or more for each SpaceLab mission it flies while the U.S. has nothing that even approaches that magnitude of commitment, the report said. The Germans already have flown one SpaceLab mission, and are trying to get NASA to book a third.

Fletcher was advised to add a dedicated SpaceLab mission for U.S. microgravity sciences to the space shuttle manifest in 1990-92 and to augment the Shuttle with Space Industries, Inc.'s industrial Space Facility. U.S. materials scientists could be ready to fly a mission by late 1991, given adequate resources, Kathryn Schnoll, NASA microgravity science program chief, said. The U.S. has only three pieces of SpaceLab materials science equipment and new hardware would be needed for the flight.

Flights were organized by Payload Systems, Inc., the entrepreneurial company founded by shuttle payload specialist Byron K. Lichtenberg to provide science and engineering services to other space users. Payload Systems has signed up several sponsors for 13 experiments that will fly three times this week on the KC-135, which is based at Ellington Field in Houston.

on the cost overruns, said NASA may have to slip the station schedule, stretch out the program, build the station in phases or trim its scope.

NASA has two estimates for the station—one from the comptroller's office and another from the station program—and will spend the next two weeks trying to reconcile those figures before revealing them to other agencies and Congress, he said. The comptroller's estimate is in the \$14.145-billion range, while the station program estimate is \$13.2 billion, other officials said.

NASA will likely be compelled to reconfigure the station as a result of the new cost estimates, the second design overhaul in the last seven months (AWST Sept. 22, 1986, p. 16). NASA officials are trying to keep details of the new higher costs secret until the Administration and Congress have been informed. The Office of Management and Budget and Congress both will need to review and approve the station taking into consideration the higher cost. The greater expense is expected to make the station an easy target for budget officials and members of Congress who are searching for ways to reduce the federal deficit.

Cancellation Argument

Last week, the Congressional Budget Office suggested cancelling the space station program to cut the deficit because of a "lack of compelling arguments to undertake the project" to support traditional U.S. space policy objectives. The station will fulfill no significant Defense Dept. purpose and "many civilian scientific goals could be met earlier and at a lower cost with a more modest program," the CBO said. It said the station would enhance national prestige, but pointed out that it will be at least eight years behind the Soviet Mir station, launched in 1986.

Other arguments for cancelling the station are the program's diminishing ability to stay within the \$8 billion budget and doubts about NASA's ability to conclude agreements that serve U.S. interests with international partners on the division of facilities and operating costs. The CBO also pointed out that the station could require as much as 80% of available shuttle launch capacity for construction in the mid-1990s and would delay other projects with more definite benefits. CBO suggested as an alternative to cancellation "a more modest program using intermittently funded and unmanned facilities."

The Congressional Budget Office also suggested cancelling the Challenger replacement orbiter, citing claims that the

Defense Dept. Cancels Shuttle Planning Complex

Washington—The Defense Dept. has decided to stop funding the Shuttle Operations Planning Complex, the Colorado Springs-based space shuttle mission control center that was to supplement Johnson Space Center's capabilities and provide an extra margin of security for secret manned space flights.

The halt in funding for the complex, known as SOPC, is likely to be permanent, although Defense officials could decide to restart work on the complex in fiscal 1990 after space shuttle missions have resumed. The Air Force last week was planning to notify the SOPC prime contractor, IBM, that it would soon cancel a \$139-million contract for SOPC work at Falcon AFS, Colo.

SOPC cancellation is the latest sign of the Pentagon's move away from reliance on the space shuttle in favor of expendable launch vehicles. Construction of the SOPC facility was complete, although initial operating capability for the complex was not scheduled until 1992. The facility has no installed equipment and is likely to be occupied instead by satellite operations controllers at the Consolidated Space Operations Center at Falcon.

The decision to cancel SOPC was based on the reduced number of missions the space shuttle will be flying as a result of the Challenger accident.

Before the accident, NASA planned to fly 24 shuttle missions annually, about eight of which would be used by the Defense Dept. That level would have taxed Johnson Space Center's system both by demanding security provisions that exceed JSC's capability and by overloading shuttle mission control and planning facilities there.

Since the shuttle is no longer expected to fly at that annual rate, Defense Dept. officials decided that although the supplementary shuttle facility was desirable, it was not mandatory and it was canceled.

Only a few days before the decision to cancel, Air Force Gen. Robert T. Herres, commander in chief of the U.S. Space

Command, said that a backup mission control center to Johnson was needed. "That is a single node in the shuttle system that could bring the program to its knees," he said. The SOPC would not have fully duplicated Johnson facilities, but would have provided "a modest capability to control military flights, and to be able to get a shuttle down if some kind of catastrophe should develop [at Johnson] while a shuttle's on orbit," Herres said.

Factors that could reverse the SOPC cancellation decision are deployment of a Strategic Defense Initiative system or development of an operational National Aerospace Plane or second generation shuttle. Some Air Force officials believe that eventually the military will want to fly space missions that are controlled in a secure environment, and that when the decision to do so is made, the SOPC issue will be revisited.

For the near term, however, the SOPC has been canceled after about \$75 million was spent. The IBM contract, which was funded at \$139 million through 1992, will be terminated soon, with the company receiving about \$20 million of the total, including its contract termination fee.

SOPC was to have employed 487 military and 250 contractor personnel. About 130 Air Force personnel who are in training at Johnson Space Center to become the SOPC cadre of mission control experts could be affected by the cancellation. Air Force officials did not know last week whether they would be transferred or remain at Johnson.

Paul J. Weitz, Johnson deputy center director, said those Air Force flight controllers hold crucial positions in the shuttle mission control organization.

"Some of those people are key to the next shuttle missions," he said. Weitz said he believed the Air Force would transfer the military flight controllers in phases or leave some at Johnson to give NASA time to train replacement personnel. NASA requires two to three years to fully train flight controllers, he said.

for the ILLV unless the program involves NASA and takes advantage of the existing investment in shuttle technology and facilities.

Gore expressed dissatisfaction at the lack of NASA involvement in the heavy-lift launch vehicle and criticized the Administration for failing to coordinate advanced launch vehicle work being performed by NASA alone, NASA and the Air Force together, and the Strategic Defense Initiative. "A rational process

Air Force managers are opposed to using the shuttle or Titan-derived technology as the basis for the ILLV and are calling for new technology to be used in the vehicle to enable the lowest possible operating costs.

"That's a ridiculous way to proceed," Sen. Albert Gore (D-Tenn.) said. Gore said he and other Senate Armed Services Committee members will not support the Defense Dept.'s supplemental appropriations request of \$110 billion in fiscal 1987

doesn't exist" for a national decision on an HILV, he said. "Whoever gets to OMB first, gets the money."

"If NASA will not be in the transport business, NASA might as well shut its doors," he said. "NASA should be playing a lead role as the nation goes into space."

Subcommittee members also raised the topic of global competitiveness and the NASA budget.

Sen. John Kerry (D-Mass.) said he believed the space science program was taking an unfair share of launch delays, and that the slips would mean the loss of initiative, as well as a lack of students and scientists that are essential to U.S. competitiveness.

Kerry and other senators criticized the Administration for cutting the Advanced Communications Technology Satellite out of the budget and for prohibiting the space shuttle from launching commercial satellites. Riegle pointed out that the current Administration will be in office for only two more years, and that the shuttle commercial launch policy could be changed in the future. Riegle said the White House policy could lock the U.S. out of the commercial launch market for the next 15 years.

"I feel very strongly that we should stay in that business. We shouldn't yank NASA out of it when we don't have a private sector alternative," he said. □

Easy Rider

Imaging scientists at California Institute of Technology's Jet Propulsion Laboratory in Pasadena have released their first movie—based on a single Landsat satellite photograph. The 127-sec-long feature is a three-dimensional, high-speed aerial ride over southern California, starting above Santa Catalina Island and passing over Newport Beach, the San Andreas Fault and downtown Los Angeles before crashing armchair viewers into the Rose Bowl. The movie was a proof-of-concept project to demonstrate technology for satellite-based, computer-aided global cloud cover studies. Photo enhancement required five days and 11 hr. of mainframe computer time.

WASHINGTON STAFF

AVIATION WEEK & SPACE TECHNOLOGY/FEBRUARY 2, 1987 17

NASA space goal studies being coordinated by astronaut Sally K. Ride are focusing on five options that will be presented to senior NASA management. The return of U.S. astronauts to the Moon to establish a lunar base is one option, as is an intensive investigation of Earth from space. An unmanned Mars sample return mission that could evolve into a manned U.S. Mars flight in about 30 years and an accelerated program that could land U.S. astronauts on Mars in 15-20 years are also options. A fifth is an unmanned Mars sample return that would act as the project flagship for several ambitious unmanned missions to various bodies in the solar system. NASA management will mix and match elements of different options. Although three of the five involve Mars, the agency continues to support delaying the Mars Observer mission by two years to 1992.

SDIO on Verge of Producing Kinetic Kill Vehicle

Washington—The Strategic Defense Initiative Organization is on the verge of producing a cost-effective space-based kinetic kill vehicle capable of destroying intercontinental ballistic missiles during their boost phase, SDI officials believe.

"The optimum weight for a space-based kinetic kill vehicle [SBKVV] is approximately 250 lb.," an official said. "We know that within 24 months from now ahead we could build a 500-lb. SBKVV that would be 100% capable against an ICBM.... After that the only challenge left is weight," the SDI official told AVIATION WEEK & SPACE TECHNOLOGY.

SDIO confidence is high because of what was demonstrated on the SDI Delta 180 space experiment last Sept. 5, when a kill vehicle—equipped with a Navy/Hughes Phoenix air-to-air missile radar tracker—acquired, tracked and then actively maneuvered to intercept and destroy another satellite (AW&ST Sept. 15, 1986, p. 19).

SDIO has no plans to fly a 500-lb. SBKVV because "That's just a drill.... We know we can do that," the official said. "We didn't know we could do [the Delta] 180 [the Sept. 5, 1986, mission test].... There was a lot of doubt in our minds whether we could really pull that off, but flying this 500-pounder is a piece of cake."

The significance of the 250-lb. SBKVV lies in its cost-effectiveness. "You've got to make killing boosters cheaper than building boosters so that the guy's on the wrong side of the cost curve," the official said. If the weight could be lowered to 220 lb. (100 kg), "there is no way they can build boosters... cheaper than our interceptors."

The problem is not the price of the interceptor but the cost of putting it in orbit, according to the official.

The small SBKVV's would be clustered in low-flying satellites that the SDIO calls "garages." How many SBKVV's are clus-

tered in each garage depends on how creative a target the garage can be allowed to represent to the enemy. "Maybe six maybe 12, maybe 24," the official said.

SDI's rough requirement to park 5,000-10,000 SBKVV's in garages in low Earth orbit equates to 200-400 garages as a minimum—using the arbitrary figure of a million SBKVV's per garage. The garages would have to be spaced tactically to account for those absent from the fight due to their position in orbit, a factor referred to as the absentee ratio. Total U.S. launch requirements will depend on many variables, including the acceptable absentee ratio, or his varying from equatorial to polar and the actual number of SBKVV's per garage.

Such a kinetic energy weapon system also would require surveillance and battle management systems in space. The surveillance systems would be used to acquire the ascending ICBMs and work with the battle management system to assign targets to interceptors. Some of the battle management satellites might be in geostationary orbit, while others might be lower, the official said.

Target Discrimination

This layer of the defense, however, which is designed to go after both the boosters and the buses carrying reentry vehicles, does not require any assistance in discriminating targets from decoys since everything it sees is a target.

Divert systems that will enable the interceptors to maneuver rapidly as they home on their targets are another critical factor in the SBKVV equation. Lateral acceleration rates of 2-3g's are required. "They have to be fast and they have to be powerful," he said.

Fast-burn boosters, often cited by critics as a defense against such a system, are not a credible or realistic counter, the official said. The chief effect of a Soviet decision to build them would be to decrease reentry vehicles that could be launched, thus decreasing the number of targets the defense would be required to destroy. □

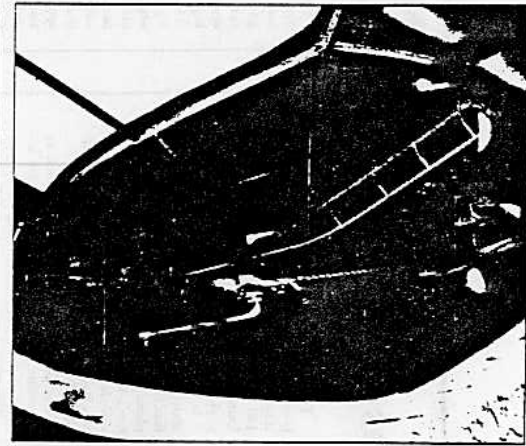
Mars Observer Launch Delay Criticized

Washington—NASA's recent decision to schedule pressure early in the recovery delay the space shuttle launch of the Mars Observer spacecraft from 1990 to 1992 is being questioned by some members of Congress, program contractors and space interest groups, who are urging that NASA buy a Titan 3 expendable booster to launch the mission on schedule.

NASA was directed Jan. 29 by Rep. Bill Nelson (D-Fla.), chairman of the House space science and applications subcommittee, to maintain the 1990 launch date in its budget planning until the decision to delay could be reviewed by Congress. Nelson noted the estimated large cost increases associated with the delay and said, "It seems evident that NASA should seriously consider alternative launch systems such as the Titan 3 for payloads that do not require man."

In informing Congress of the slip, NASA Administrator James C. Fletcher cited the need to prevent the space shuttle from being subjected to unnecessary manned Mars exploration.

Distance Record Set for Human-Powered Flight



Michelob Light Eagle human powered airplane set the distance record for its class at 37.3 stat. mi. while undergoing flight testing at Edwards AFB, Calif., on Jan. 22 (photo 1) (AW&ST Jan. 26, p. 30). The airplane—built by the MIT-based Daedalus Project—has a 11.4-ft. wingspan and 320 sq. ft. wing area, weighs 91 lb. empty and cruised at 16.6 mph., consuming 0.31 hp. Steering is primarily through an all-flying rudder operated by a right hand control stick, and roll control is through all-flying wingtips that pivot at the main spar, controlled by the left hand stick (photo 2). The right hand stick also controls pitch via an all-flying conventional tail, which project officials said was more efficient than a canard. A carbon-fiber driveshaft connects the pedals to the variable-pitch propeller. Main structural materials are carbon-fiber, Kevlar, polystyrene foam, and .005-in.-thick Mylar skin covering. The project's goal is to recreate Daedalus' mythical flight from Crete to the Greek mainland, a 69-stat.-mi. distance. Next step is to build another aircraft based upon the recent tests and attempt the Crete flight in April, 1988.

Soviet Proton Booster Fails; Reconnaissance Satellite Explodes

By Craig Covault

Washington—The Soviet Union has experienced two serious space failures, the explosion in orbit of a military reconnaissance satellite and the loss during launch of an SL-12 Proton booster, the most powerful Soviet rocket.

The Jan. 30 Proton failure during launch of a communications satellite mission is the largest space vehicle accident since loss of the shuttle Challenger and a U.S. Air Force Titan during launch in 1986. The 770-ton Proton is comparable in size to the Titan.

The other failure involved the deliberate explosion of a military reconnaissance satellite Jan. 29, to prevent the malfunctioning vehicle from falling into U.S. hands.

The Proton booster failure will hinder attempts to market international launch services on the SL-12, and the Soviets have tried to keep the \$50-million accident secret. The 187-ft.-long vehicle is capable of placing 2 tons in geosynchronous orbit. The four-stage Proton was launched from Baikonur Cosmodrome at Tyuratam at 7:19 p.m. Jan. 30, according to Geoffrey E. Perry, who heads the Kettering Space Observer Group. Analysis by Perry and U.S. intelligence sources indicates the vehicle was carrying a large communications satellite headed for geosynchronous orbit.

Soviet Proton booster failure occurred in the fourth stage, as indicated in the drawing of the 187-ft. vehicle at left. New data on the Proton indicate that the side-mounted first-stage pods are not strap-on boosters as believed earlier, but rather fuel tanks that remain attached during the entire first-stage flight like those on the earlier U.S. Saturn 1B. The Proton also is used in a three-stage version to launch Salyut and Mir space station vehicles. Design of the unmanned Cosmos 1818 reconnaissance satellite that exploded is nearly identical to the Soviet Vostok manned vehicle design shown at right. The Soviets destroyed the satellite to prevent it from falling into U.S. hands after the imaging reconnaissance vehicle failed to descend over the Soviet Union as planned. In the unmanned military reconnaissance version of the Vostok, the camera system and film are contained in the large spherical ball, which is returned to Earth.

The first three stages of the Proton functioned normally, placing the 22-ton fourth stage and its satellite payload into a low 140 x 199-mi. parking orbit, where the fourth stage failed to ignite and propel the payload toward geosynchronous altitude.

When the vehicle was off West Africa above the Gulf of Guinea, however, a malfunction occurred that ended the launch phase prematurely, Perry said. The Proton's fourth stage failed to ignite, and the vehicle separated into four pieces. The debris from the Proton fourth stage and satellite fell out of orbit within 24 hr.

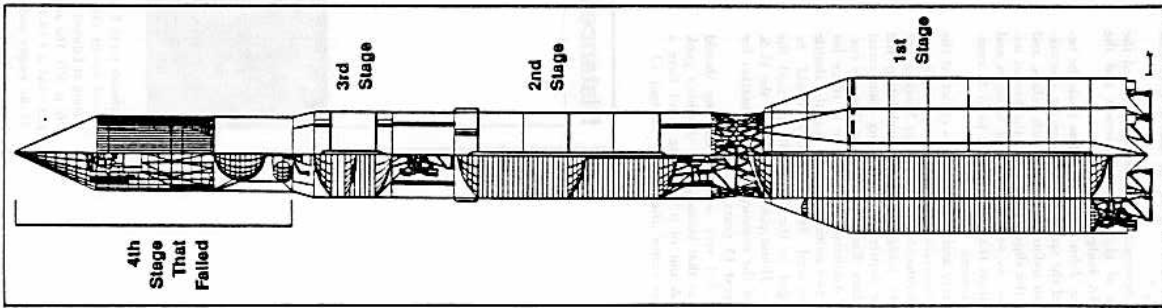
The Soviets characterized the launch as a routine low-altitude satellite mission instead of the failure of their largest booster.

The 20,000-lb.-thrust "Block-D" fourth stage that failed is powered by kerosene and liquid oxygen.

The other Soviet space failure involved the Cosmos 1813 military reconnaissance satellite.

The Soviets commanded the reconnaissance vehicle to explode in space Jan. 29 after the satellite malfunctioned and failed to return its payload to Earth as intended.

The military space vehicle had a design similar to that used by the old Soviet Vostok manned spacecraft and was launched from the Northern Cosmodrome at Plesetsk on Jan. 15. It was to fly a 14-day mission photographing various tar-



NASA, Contractors Weigh Options For Orbiter Flight Readiness Firing

Kennedy Space Center—NASA field managers and principal contractors met here last week to develop a list of options regarding the need and strategies for a flight readiness firing (FRF) of the orbiter Discovery prior to resumption of space shuttle flights next year.

In addition, NASA is targeting the earliest flight date in its options as Mar. 3, 1988, which is a two-week delay from the last official date. The Mar. 3 date would be possible if crew escape hatch modifications were not made and the FRF were not conducted. A blowaway escape hatch has been approved for the orbiter fleet, but no decision has been made on whether it will be installed on Discovery prior to the first flight.

The ultimate decision whether to conduct the FRF will be made by Rear Adm. Richard H. Truly, NASA space flight director, who is expected to consider operational, technical and possibly training

requirements in his verdict (AWST Jan. 26, p. 26). An overwhelming influence on the decision will be the vote of the flight crew.

The long standoff between the Challenger accident (Jan. 28, 1986) and the next shuttle flight could prompt NASA to use the opportunity to exercise crews and equipment and accept the certain added delay in flight resumption that would come with an FRF. In addition, there has been a significant change in the Kennedy organizational structure and overall NASA count-down and launch personnel since the Challenger accident. Proponents of an FRF said the new personnel would benefit from both a practiced countdown and an engine firing, even if no hard operational or technical requirements are established.

In their deliberations last week, managers from Kennedy, Johnson and Marshall along with Lockheed Space Operations Co., USBI, Martin Marietta and Rockwell International were considering schedule op-

erations. ■ Conduct an FRF Feb. 17, 1988, and launch Apr. 14. This would account for contingencies including late component deliveries.

If ever, used by a Soviet spacecraft. The spacecraft has the characteristics of being launched by an SL-11 booster, the space shuttle version of an SS-9 ICBM. Its altitude is like that used by store/dump communications satellites, but its inclination is similar to that used for ocean surveillance. □

SH-60B Helicopter Crash

Washington—Both the U.S. Navy and Army are investigating the crash of a Navy/Shorsky Aircraft SH-60B near Tampa, Fla., last week to determine whether the tail rotor failure in the helicopter could be the key to earlier unexplained accidents.

The Navy airborne multipurpose system Lums Mk 3 was en route between Key West and Mayport, Fla., on Feb. 2, with two other helicopters, when the tail rotor stopped in flight near 5,000 ft. The pilot was able to land the SH-60B in a plowed field, sustaining damage to the helicopter but no serious injuries.

Investigation of the helicopter revealed that the tail rotor had frozen in flight when a malfunctioning oil cooler restricted oil flow to the tail rotor system. A Navy SH-60B crashed over water in 1985. The cause of that accident was never explained, and the service is sharing its recent investigation data with the Army. The Army has experienced UH-60 accidents in the past few years in which the cause of the accident could not be determined.

reentry vehicle down anywhere along its ground track.

To prevent the vehicle from being recovered for analysis by U.S. intelligence or striking a populated area after an uncontrolled reentry, the Soviets activated the vehicle's destruct system and blew the satellite into more than 100 pieces.

The explosion occurred at about 6 a.m. GMT when the spacecraft was over the northeast USSR and blew debris into orbits more than 100 mi. higher than the spacecraft's 240-mi. orbit at the time it was destroyed.

Despite the two failures, the Soviets have maintained a launch pace that by the end of February will total as many missions as the U.S. will launch through all of 1987.

Five Soviet space missions launched since late January are:

■ Cosmos 1814—This store/dump communications satellite was launched Jan. 21 into a 506 x 481-mi. orbit inclined 74 deg.

■ Cosmos 1815—This military technology satellite was launched from the Volgograd Station Cosmodrome at Kapustin Yar Jan. 22 into a 341 x 214-mi. orbit inclined 50.17 deg.

■ Molniya-3—The communications spacecraft was launched into a highly elliptical orbit Jan. 23.

■ Cosmos 1816—The navigation satellite was launched Jan. 29 into a 636 x 607-mi. orbit inclined 82.9 deg.

■ Cosmos 1818—The satellite was launched late Feb. 1 into a 503 x 490-mi. orbit inclined 65 deg., parameters rarely,

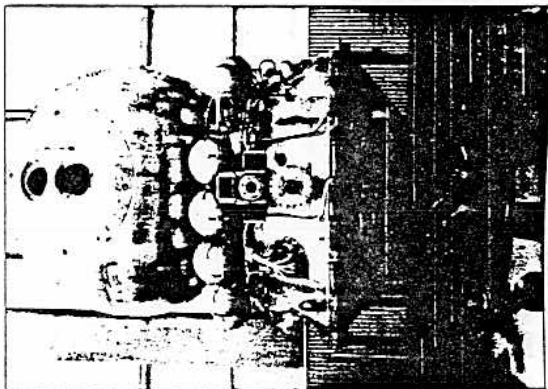
Cosmonauts Launched

Washington—Two Soviet cosmonauts were completing a rendezvous with the Mir space station last week following their night launch from Tyuratam Feb. 6 on board the new Soyuz TM-2 spacecraft.

The launch of cosmonauts Yuri Romanenko and Alexander Laveykin occurred at 12:38 a.m. Moscow time on board an SL-4 booster. They are the first crew to pilot the new TM version of the Soyuz, which appears identical to the 20-year-old Soyuz design but has more advanced systems. Unlike the older Soyuz, the TM version can complete its rendezvous with the Mir by approaching from any angle. This saves station fuel by avoiding the need to maneuver the Mir continually during the rendezvous.

The new Soyuz also has a lighter launch escape system allowing the launch of more payload and a new end-of-mission descent parachute that permits more payload to be returned to Earth from station flights.

The crew is expected to remain on board Mir for about 10 months.



Congress, Booster Manufacturers Criticize Joint Redesign Program

By Craig Covault

Washington—NASA is being criticized for failing to include a full range of U.S. solid rocket motor companies in the Morton Thiokol-led effort to redesign the solid booster that caused the shuttle Challenger accident.

Concerns are surfacing from outside companies, review groups and Congress that the new Thiokol joint design could limit booster reusability, placing further constraints on shuttle flight operations. NASA disagrees with this assessment.

Differing companies are proposing alternate block-2 shuttle booster designs to improve safety and enhance reusability.

The Senate Commerce subcommittee on science, technology and space is ordering NASA to formally integrate expertise from at least four other companies in the Thiokol booster redesign effort.

Funding Approval

The subcommittee last year approved funding to support such additional participation and believes NASA failed to carry out the subcommittee's will by not seeking more formal participation by U.S. booster companies other than Thiokol.

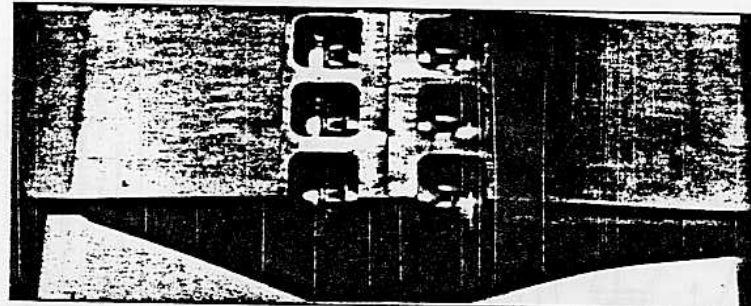
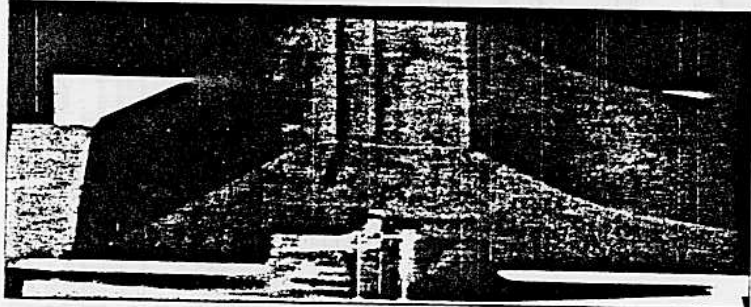
Representatives from Aerojet, Atlantic Research Corp., United Technologies and Hercules told the subcommittee they have been involved informally in some redesign assessments, but have not been part of a specific effort. United Technologies' Chemical Systems Div. has been most involved and has transferred information learned from its Titan solid motor failure to the shuttle effort.

The subcommittee is concerned about the lack of involvement by all the U.S. solid rocket makers, according to chairman Sen. Donald W. Riegle, Jr. (D-Mich.). "It was our intent that you be involved in the redesign and you might be involved more than on an informal basis," he told the manufacturers at a Senate hearing.

Sen. Albert Gore, Jr. (D-Tenn.) told the manufacturers that, in an event such as recovery from the Challenger accident, the entire solid-rocket industry should be involved.

J. R. Thompson, Marshall Space Flight Center director, said that NASA has tried to maintain a data exchange on an informal basis, and that this approach was being taken because NASA's primary contract is with Thiokol.

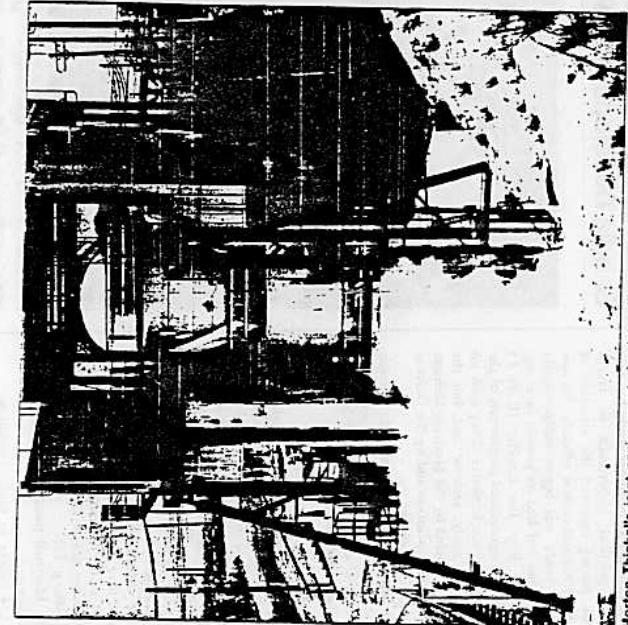
The companies earlier were given \$500,000 each for a critique of the NASA/Thiokol redesign and proposals for block-2 shuttle booster concepts. The



New shuttle booster design proposed by Atlantic Research Corp. would use bolted segment joints that would simplify assembly and prevent the flexing in the joint that contributed to the Challenger accident. NASA Langley Research Center has been working with Atlantic Research on this design, shown here from the outside at right and the inside at left.

funding was used primarily for block-2 work, although some of the companies reported concerns about elements of the current Thiokol design. These concerns include reusability of the segments as a result of the addition of the capture feature to prevent booster joint rotation at ignition.

James R. Sides, senior vice president and general manager of the Atlantic Research Corp. Propulsion Div., said his company believed Thiokol was properly addressing the deficiencies that led to the Challenger accident, but that the redesigned shuttle booster clevis and tang joint "has a higher risk of O-ring or hardware damage" during assembly. "Although any



Morton Thiokol's joint environment simulator fires a small propellant load demonstrating modifications to shuttle booster joints incorporated in two joints on the rig. The device simulates the initial pressure pulse through the motor at ignition.

problems as a result of the complexity of the redesigned joints."

Concerns also were expressed by Ernest A. Mettenet, Hercules Aerospace Products Group president. "From our point of view, inspection and certification of the bolted insulation joint represents a difficult task that deserves maximum attention by the NASA redesign team," he said.

A National Research Council report addressed similar issues. "We are concerned that the baseline design may not readily allow for reworking or inspection of the hidden surfaces of the capture feature," it said. Guyford Steyer, NRC committee chairman, wrote NASA Administrator James C. Fletcher. "We conclude that this problem requires special attention since it could be sufficiently serious to prohibit reuse of the case segments if the finishes and absence of corrosion cannot be satisfactorily verified."

John Thomas, who heads the booster redesign effort at Marshall, believes the Research Council concerns can be reduced or eliminated if the capture feature

be converted to "factory joints" like those on the existing booster. The factory joints have had no problems. Insulation would be applied to the entire motor interior, offering no leak path to the joints. The propellant load would be poured at one time to create a monolithic grain. The boosters then would be barged to Kennedy Space Center, where they would be stacked without the extensive buildup now done. New cranes capable of lifting 1 million lb. could be procured as off-the-shelf hardware.

Atlantic Research—NASA's Langley Research Center and Atlantic Research worked jointly on a new bolted flange concept that would use a double case joint. The bolted flange would eliminate joint rotation at the sealing surface, provide simple assembly at Kennedy and support at least 19 reuses. Individual cases double the length of the current pieces would eliminate factory joints. This reduction offsets the extra weight of the flange, reducing the booster's inert weight by almost 5,000 lb. and allowing an increase of over 1,800 lb. in propellant. The new boosters would not only use a simpler design but would provide a 1,000 lb. shuttle payload weight increase.

Chemical Systems Div.—The company proposed a monolithic design with the motor cast in one segment, and using existing hardware, much like the Aerojet proposal. Congressional staffers praised what they called the "innovative approach" taken by Chemical Systems Div. since its Titan motor operations are keyed to segmented boosters, like the existing shuttle design.

Hercules—The company that initially developed the booster capture feature in connection with the filament-wound motor program proposed retaining the segmented motor approach. Hercules believes experience from the accident and inherent handling benefits of smaller motor segments can result in a much safer block-2 design with increased performance. The company believes highly reliable joints can be designed for use in a segmented motor, and that such a motor could use the Hercules filament-wound case for greater flight performance.

Morton Thiokol—The current booster contractor is proposing a segmented design with nozzle and case joint improvements. Thiokol believes monolithic designs would have adverse burn characteristics compared to segmented sections poured separately. The company believes the current redesign emphasis is a significant step toward a block-2 space shuttle booster. □

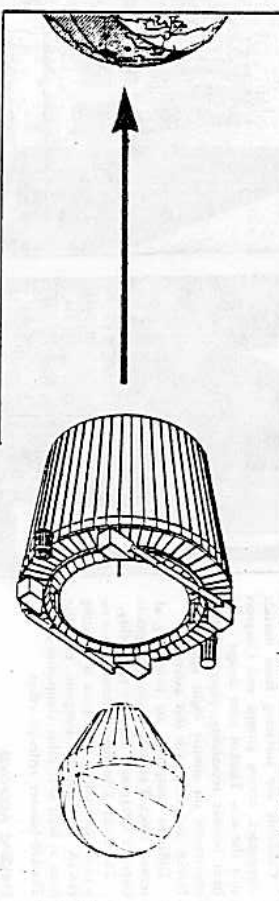
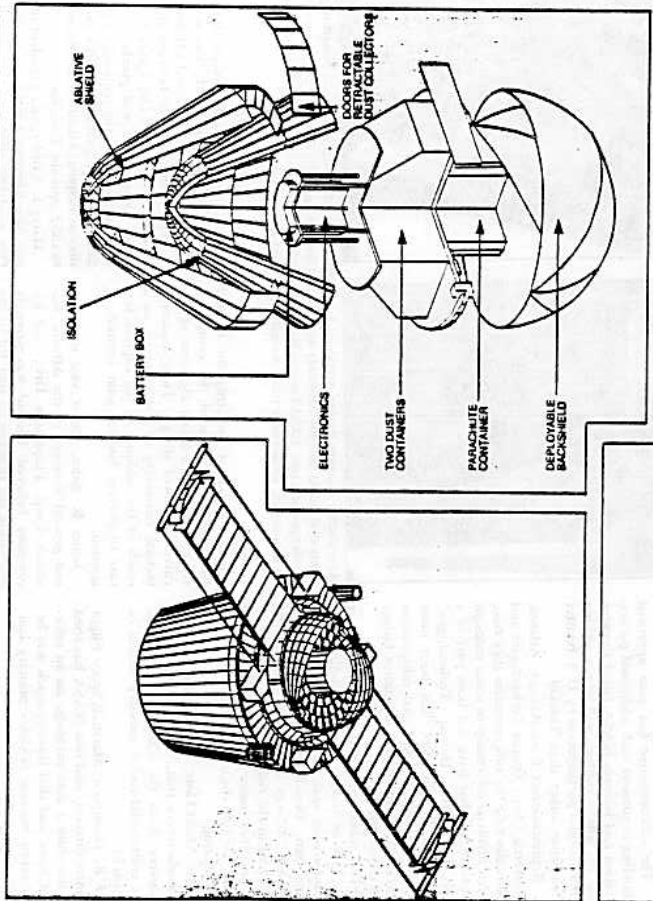
design is explained further to the committee, NASA is planning those discussions soon, he said.

The new block 2 design concepts represent diverse options that could be cycled into the shuttle program over the next several years, following resumption of flight operations using the modified Thiokol boosters. NASA has not decided yet, however, whether to pursue any type of block-2 program.

Two companies proposed monolithic designs in which the booster's entire propellant load would be poured at one time, two proposed retaining improved versions of the existing concept, and a fifth offered a joint concept that would reduce the number of segments on each booster. The shuttle block-2 booster proposals are:

Aerojet—The monolithic concept proposed by Aerojet would eliminate the O-ring seal failure problem and use all existing solid rocket motor components. The segments would be assembled without propellant at Aerojet's facilities near Huntsville, Ala. The field joints would

Proposed Caesar Comet Encounter Vies for ESA Authorization



Europe's proposed Caesar comet encounter mission would include the collection of coma dust and gas samples for detailed analyses after the samples are returned to Earth. Caesar is one of several science missions that are competing for European Space Agency authorization as a program new start for the late 1980s/early 1990s. Drawing of Caesar (top, left) shows its dust and gas collectors in the deployed/open mode during the spacecraft's relatively slow encounter of a short-period comet at a speed of 10 km/sec. or less. Following the encounter, Caesar would be targeted for a return to the Earth's vicinity, where the though dust particles may not have been collected totally intact.

reentry capsule with its slowed dust collectors would be separated for retrieval (directly above). Exploded view (top, right) details the reentry capsule's dust collectors, electronics and protective shields. The Caesar mission proposal has been criticized by some scientists, who believe that flyby speeds of about 10 km/sec. are too high to collect dust particles intact. Supporters of the concept claim that the mission has a high scientific value for its relatively modest price, and that isotopic and chemical analyses can be performed in Earth laboratories with the samples even though dust particles may not have been collected totally intact.

STRATEGIC DEFENSE INITIATIVE

Pro-SDI Panel Forecasts \$121-Billion Antimissile Costs, Excluding Research

Washington—The \$121-billion cost estimate projected by the George C. Marshall Institute for a strategic defense system includes development but not research costs, according to institute president Robert Jastrow (AASST Jan. 26, p. 22).

Jastrow, who founded NASA's Goddard Institute for Space Studies, told AVIATION WEEK & SPACE TECHNOLOGY the institute allocated projected development costs over the entire defense system, so that they are a part, for example, of the \$6-million estimated cost per space-based kinetic kill vehicle.

Budget Allocation

"Research costs were not included in the panel's estimate because they are subsumed in the Strategic Defense Initiative budget," Jastrow said. "I estimate that the part of the SDI budget allocable to the type of kinetic energy defense our report describes will be \$10-15 billion by the time full-scale engineering development commences."

The institute's December study has taken on political importance in recent weeks, having captured the attention of top-level Administration officials. Jastrow said the study was begun independently last October but had its genesis in a suggestion by Rep. Jim Courter (R-N.J.) and other congressional proponents of the Strategic Defense Initiative. They took no part in the study, Jastrow said, but the panel was briefed by the Strategic Defense Initiative Organization and by the Defense Intelligence Agency.

All three layers of antimissile defense assumed by the Marshall panel would deploy kinetic energy weapons, rather than lasers and particle beams.

'Evolutionary Development'

"A space-based boost-phase defense using energy weapons is not a quantum leap beyond existing defense technologies," the study said, "but an evolutionary development out of relatively mature technologies of air defense. The direct applicability of air defense technology to space-based boost phase defenses was verified recently in the Delta 180 experiment, which showed that no show-stoppers stand in the way of using established technology in a space-based missile defense" (AASST Sept. 15, 1986, p. 19).

The Marshall panel projected this cost breakdown:

- \$54 billion to initial operation.
- \$121 billion to full operation.
- Includes \$3 billion for one year's worth of operations and maintenance.
- \$10-15 billion in annual costs, or

1-4% of likely defense spending levels through the mid-1990s.

■ Separate costs for the space-based, midcourse and terminal layers would fall into an approximate ratio of 4:2:1, respectively.

■ Cost per interceptor of the kinetic kill vehicles in the space-based layer is \$1.5 million, according to independent studies by three contractors and by the Defense Dept.

■ Cost of launch to orbit for each kinetic kill vehicle would be \$750,000 (\$1,500 per lb. for 500 lb.).

■ Operational and maintenance costs for a 10-year life cycle are projected at \$1.5 million per kinetic kill vehicle.

■ Total cost of the 10 sensor satellites in low-Earth orbit required by the system would be \$10 billion, based on estimates for production and launch of military satellites with comparable instrumentation.

■ Cost of four sensor satellites in geosynchronous orbit is \$4 billion, the same

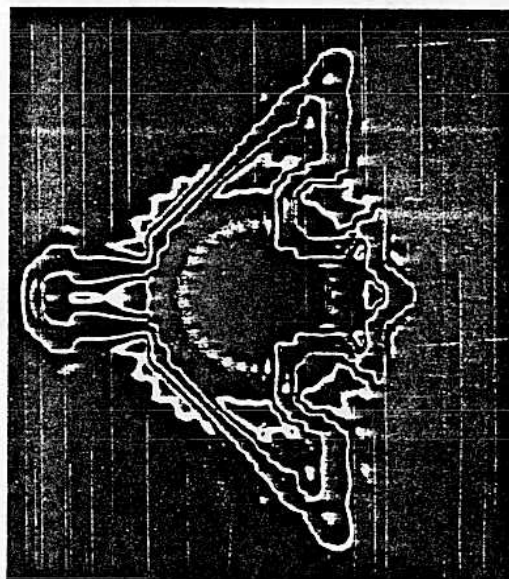
as the cost of the four other geosynchronous satellites required.

■ \$68 billion is the overall cost projected for a fully deployed space-based layer, including 11,000 kinetic kill vehicles, weapons-carrying satellites and supporting sensor satellites.

In a current critique of SDI, titled Empty Promise, the Union of Concerned Scientists said rationales to justify partial deployments were to be expected, given the radical nature of President Reagan's call to render nuclear weapons impotent and obsolete.

"Whether seen as a fallback position or as a transitional step, limited defenses have become the practical focus of the SDI program," the union said. It concluded that a first-generation SDI system would be unlikely to include boost-phase weapons, "whose feasibility even in the long term is highly questionable. Instead the emphasis is likely to be on terminal defenses." □

Sandia Develops New Pattern Recognizer



New "lock and tumbler" holographic technique created this computer-generated reconstruction of the drawing of a delta-wing aircraft (above), as part of an advanced optical pattern recognition effort at Sandia National Laboratories.

Soviet Long-Duration Crew Activates Mir Space Station

By Craig Covault

Washington—The Soviet Union last week began a long-duration mission on the Mir space station with a cosmonaut crew that will use extravehicular activity and large modules launched from Earth to expand the facility.

The first flight directly supports the Soviet Union's key space goal—establishment of a permanently manned station that will be enlarged substantially to expand military, scientific and space applications and enhance the prestige of the USSR. The new Soviet mission represents a significant space endeavor the U.S. will be unable to match until the mid-1990s, and European scientists have started turning to the Mir's capability.

Analysts believe part of the Mir crew time will be devoted to military objectives. The station will first be doubled in size, then grow eventually to a 200,000-lb facility.

Cosmonauts Col. Yuri Romanenko and Alexander Laveikin will conduct one or more EVAs that will demonstrate structures deployment and erection of a large new solar array on the station's exterior. The new array will supplement the vehicle's primary arrays, which span 97 ft and provide more than 10 kw of power.

The first of four or five large modules that will be launched to the station is undergoing final checkout at the Baikonur Cosmodrome at Tyuratam, awaiting launch on a Proton booster.

The launch will not be affected by the Jan. 30 SL-12 Proton failure, since that malfunction occurred in a fourth stage, which is not part of the three-stage SL-13 Proton version used for station support.

The new "Roentgen" module is expected to weigh about 40,000 lb. and carry four X-ray telescopes developed by Soviet, Dutch, West German and European Space Agency scientists with additional participation by British investigators.

A second 40,000-lb. module with a large Earth resources camera system is expected to be launched to the station in late 1987, possibly after the current crew is replaced by a new team of cosmonauts. Romanenko and Laveikin were launched Feb. 6 on board the Soyuz TM-2 spacecraft and flew a two-day rendezvous chase before docking with Mir Feb. 8 at 2:28 a.m. Moscow time.

The docking occurred on the forward port of Mir's five-port hub, creating a complex about 92 ft long with a mass of more than 72,000 lb. This includes the Progress 27 tanker/transport, which docked with Mir earlier in January and is still attached to the station's rear port.

One of the crew's first activities was to begin unloading nearly 2,800 lb. of provisions from the Progress, and prepare the station for transfer of up to about 2,200 lb. of propellant from the tanker. The Progress also carried new bottled air to recharge the station's atmosphere.

Soyuz Advances

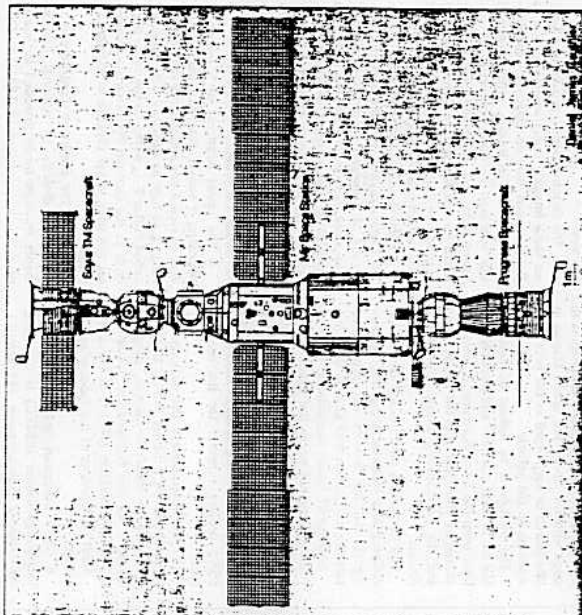
Use of the modernized Soyuz TM-2 design has allowed the Soviets to introduce additional mission flexibility into their station operations. The Soyuz launched Feb. 6 appears identical structurally to the version used for 20 years, but the computational capability of the vehicle's computers has been greatly increased. The Soyuz TM version used a lighter weight escape tower system during the first 2 min. 30 sec. of launch, and as a result could carry more than 400 lb. more material compared with previous Soyuz ascents (AWX51 Feb. 9, p. 27).

Further advances include use of lighter primary and backup parachutes, which will enable the crew to carry nearly 300 lb. more material from the station when they return, compared with previous descent loads.

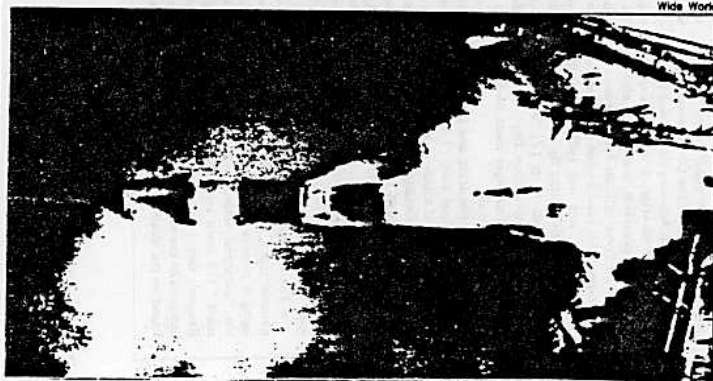
For the first time, the TM version also provided two separate air-to-ground communication lines, allowing the cosmonauts to hold simultaneous conversations with different spacecraft communicators in the mission control center.

Romanenko and Laveikin performed three firings of the Soyuz main engine to bring their transport into the same 230 x 203-mi. orbit as the station, then used the TM's new Kurs (course) computer system to complete the rendezvous. Although the Kurs system had been tested during an unmanned flight with the Soyuz TM last summer, this was the first time it was used by a manned crew.

The system includes new avionics mounted in the station's nose. The station



Docking of the Soviet Soyuz TM-2 spacecraft to the Mir station by a two-man cosmonaut crew created a complex about 92 ft. long and weighing more than 72,000 lb. The Soyuz, with small solar arrays, is shown docked to the forward center port on the Mir hub, while a Progress tanker/transport remains docked to the aft end. Mir solar arrays span 97 ft. The Soviets are expected within a month to command the unmanned Progress to separate, allowing the cosmonauts to manually detach their Soyuz and pilot it to the aft port. This will permit the docking of a large unmanned astrophysics module on Mir's forward hub.



Wide World

Soviet SL-4 booster carrying the Soyuz TM-2 spacecraft lifts off from its launch pad at Tyuratam at 12:38 a.m. Moscow time Feb. 6 (left). The Soyuz TM-2 carried a modified, lighter weight escape tower system that enabled the launch of a heavier Soyuz payload. This was the third manned liftoff televised live by the Soviets, following their Apollo/Soyuz Test Project launch in 1975 and launch of the first Mir crew in 1985. Cosmonauts mission commander Col. Yuri Romanenko (above left) and Alexander Laveikin practice water landing survival prior to their launch. They will attempt a new manned space flight duration record of about 10 months. Romanenko spent three months on Salyut 6 and commanded an earlier Soyuz mission. Laveikin is making his first flight.

ing, Colorado Springs. Johnson conducts extensive Soviet space assessments. He believes the new design may be incorporated into Mir, since the engine systems of the Salyut 6 and Salyut 7 stations experienced major breakdowns after those platforms had been in space for long periods.

Romanenko and Laveikin are expected to stay on board Mir for about 10 months, breaking the 237-day manned flight record set by an earlier crew on Salyut 7.

They are to be visited by a Soviet/Syrian crew set for launch on July 22. During 1988, two additional international crews will visit Mir including a Soviet/Bulgarian crew in early 1988 followed by a Soviet/French crew.

Altitude Adjustment

Romanenko and Laveikin completed initial activation of Mir Feb. 11 and used the Progress rocket engine to adjust the station's altitude on that same day.

Once Progress unloading is completed, the unmanned vehicle will be separated from Mir and sent into a destructive reentry. Romanenko and Laveikin then are expected to enter Soyuz TM-2, separate it from the station and redock at the aft port vacated by the Progress.

This maneuver will free the forward center port for docking of the large astrophysics module. Once docked on the center port, the module will attach a deg.

small manipulator arm to a fixture on the Mir hub and slowly leverage itself around to one of the side ports. This procedure is necessary since Mir avionics can command a completely automatic docking only on the forward-facing centerline port.

The Soviets also have been shown training with a somewhat smaller rear-mounted module, but have not discussed its purpose.

Communications with Mir are being maintained through the Soviets' ground station network across the USSR and its tracking ship fleet, including the Yuri Gagarin anchored off Nova Scotia. The Soviets had hoped Mir would relay communications through the Cosmos 1,700 geosynchronous-orbit relay spacecraft, but it has failed and drifted off station.

The Proton's Jan. 30 launch failure resulted in the loss of a geosynchronous communications spacecraft that could have been intended to replace Cosmos 1,700. Loss of the vehicle, if it was a relay, has not significantly disrupted Mir operations.

While Mir mission activities were under way, the Soviets continued unmanned launch operations. The Cosmos 1,819 reconnaissance satellite was launched Feb. 9 into a 138 x 122-mi. orbit inclined 72.8 deg. □

U.S. Proposal Would Restrict European, Japanese Station Use

By Theresa M. Foley

Washington—The U.S. has proposed restricting its own space station hardware elements for dedicated American use, and allowing to Europe and Japan—both of which plan to contribute pressurized modules—50% use of their own hardware elements and no use of the U.S. modules.

U.S. officials last week met with European, Canadian and Japanese space officials here to brief them on the new U.S. negotiating position and formally present proposed agreement language that will allow the U.S. Defense Dept. to use the station. The U.S. and its partners remained far from agreement on several key areas.

At the meeting, U.S. officials explained the new draft intergovernmental agree-

ment, which was approved Feb. 3 by the Defense Dept. and other agencies, to the partners. One representative at the meeting called the draft "disappointing." European space officials continue to believe that they are not being treated as equals by the U.S. and that they should be given an equal voice in managing the station. The most recent U.S. draft agreement appeared to deny all the basic assumptions about European participation in the program, a European space official said.

The U.S. position on allocation of station use among the partners underwent an important change in late 1986, according to several station analysts. The earlier U.S. position was that all station elements must be open to all partners. Under the currently proposed arrangement, only the U.S. and Canada would have the right to use all station elements. Europe and Japan

would be allocated 50% use of their respective hardware contributions, and no use of U.S. or Canadian hardware unless special arrangements were made.

NASA has proposed that the Canadians, who are contributing the Mobile Service Center, be given 3% of space station user accommodations on elements provided by the other partners and on its own element. NASA proposed that since it is providing the station's named base infrastructure, including some resources necessary to operate the Mobile Service Center, the agency be provided the remaining use of the MSC.

Under this proposal, Canada would contribute 3% of the station hardware, receive 3% of its use, and be asked to pay for maintaining its hardware element and 3% of the overall station costs.

The issue of who controls the station

Industry Group Criticizes Air Force Draft Agreement on ELVs

Washington—An Air Force draft agreement for commercial use of the service's expendable launcher facilities would not encourage development of private U.S. launch companies and would discourage satellite customers from contracting with them, an industry group told the Defense and Transportation departments.

The chairman of the Commercial Space Transportation Advisory Committee (Comstac), Allan McArdor, a Federal Express senior vice president, praised the attitude of top Air Force officials toward commercial expendable vehicles but said that top level support was not reflected in the draft agreement written by lower-level officials (ENR Feb. 9, p. 17). Senior Air Force and Transportation Dept. officials have agreed that changes must be made to the draft, he said.

In a report on the draft, one U.S. satellite industry official said, "I believe that [the agreement] is totally unacceptable to the commercial satellite industry and unless the government can think 'commercially,' there will be no commercial launch system in the U.S."

Among the specific complaints cited in the report, released last week, Comstac said:

- The agreement fails to balance the national space policy objective of encouraging a commercial launch industry with the "parochial interests of the government." The spirit and intent of President Reagan's directives supporting the establishment of the industry "is nowhere to be found in the draft."

- The agreement "places severe burdens on new entrants" to the marketplace and could foreclose participation of entrepreneurial companies with limited capital resources.

McArdor said it was a "very positive step" that the Air Force even allowed the open industry review. He expects the Air Force to respond quickly to the Comstac recommendations, but added that the issue of liability insurance may exceed the ability of the Air Force to resolve. It may need examination at the cabinet level or higher, he said.

The insurance problem centers on the huge sums of money represented by a launch vehicle, payload, launch pad and associated equipment. In a worst-case accident, the value of private sector and government property that might be lost or damaged could exceed \$500 million. The insurance market is expected to be able to cover only a portion of that. One Comstac member noted that in the future, four launch pads could be operating simultaneously, representing an enormous risk that would be difficult to insure.

Another major issue is the type of schedule priority that will be given to commercial satellite owners sharing facilities with government payloads. McArdor said commercial users understood the need for preemption of their payloads due to a national security emergency, but needed protection against being arbitrarily bumped for government payloads that were not truly urgent to national security.

New Mir Astrophysics Module to Include European Experiments

Brussels—An astrophysics module including X-ray experiments manufactured by the European Space Agency and agencies in West Germany, Holland and Britain is to dock with the Soviet Mir space station in late March or early April as the first large addition to the vehicle.

The module is to remain docked with Mir for at least one year and possibly two. Data from the X-ray experiments are to be shared by scientists from the Soviet Union and the participating Western European nations.

The Europeans paid the full cost of developing and manufacturing their experiments, but the Soviets will provide all satellite integration and launch services. Because of Soviet restrictions, Western scientists do not know the exact launch date. "We were told that it would probably be launched in late March or early April, and we have a nominal experiment start date of the beginning of May," Alan Smith, ESA's project scientist for the mission, said.

The scientists believe the package will be launched on a Soviet Proton booster, according to Albert Brinkman, program manager for the Netherlands Space Research Organization (FRON) in Utrecht. Main components of the module are as follows:

- ESA's European Space Research & Technology Center (ESTEC) is providing the Sirene-2 high-pressure gas scintillation proportional spectrometer. Sirene-2 is an improved version of the instrument that flew on ESA's Exosat (ENR July 4, 1983, p. 62). Sirene-2 operates at an internal pressure of three atmospheres instead of one atmosphere for the Exosat.

"This is by far the fastest way to get [an X-ray observation experiment] launched," Smith said. "The next ESA X-ray satellite will not be in orbit until the 1990s, and even float is some time in the future" (ENR May 26, 1986, p. 77).

The Mir astrophysics package will give scientists a wide-spectrum X-ray survey and long-term surveillance. Much of the observation time will be devoted to studying periodic variations in the emissions of X-ray sources.

The scientists are not sure how long the Soviets will keep the package active. They were told to develop a preliminary observation program based on a one-year lifetime, but that could be extended to two years or more, according to Claus Reppin, the Max Planck project manager.

Since they will collect the data, the Soviets will have access to all raw information from the Western experiments. But the Soviets have only generally agreed to share data from their experiments with Western scientists.

"Technically we all have rights of access to each other's data, but we don't know how that will work out in practice," Smith said. "We have no guarantee of access to their raw data, but we think we could get some if we want it."

The Soviets will not allow the Western scientists to see the actual launch, though they will be allowed to visit the Soviet Union for the experiment switch-on 4-6 weeks after launch, and Western scientists will remain in Russia to monitor the package throughout its lifetime.

Cooperating with the Soviets allows scientists to quickly obtain a large return at a relatively low cost, the scientists said.

Ground Test Problems Delay Resumption Of Ariane Launches

Paris—Resumption of launches by Europe's Ariane is not expected before May/June because of delays encountered in the ground test firings that are being performed to verify changes made in the vehicle's third stage following last year's V18 failure.

A firm date for the Ariane V19 flight is expected to be set by the Ariane space management/marketing organization in March based on results of the verification/qualification tests with the third stage.

1986 Failure

Ariane launches have been suspended since the May, 1986, V18 launch failure, which was due to ignition problems in the third stage. The third-stage HM7 cryogenic engine's igniter was modified in the wake of the V18 accident, and some of its operating parameters were altered to assure a correct ignition under varying in-flight conditions (AWST Dec. 8, 1986, p. 26).

An extensive program of test-and-firings with the third-stage engine was initiated by Ariane propulsion contractor Societe Europeenne de Propulsion (SEP) to verify the modifications and qualify an engine for Ariane V19.

The delays in ground testing stem largely from an incident encountered during a firing in January of the V19 motor. Jean Sollier, SEP chairman and chief executive officer, said the test began with a correct ignition, but problems occurred during the firing, including turbopump vibrations, overheating of a bearing and a test-stand leak.

Cold Weather

A follow-up test was prepared but had to be delayed two weeks because of extremely cold weather. The firing finally was conducted Jan. 27. Sollier said ignition and the basic operation of the HM7 went as planned.

"However, we had planned to go further by varying the turbopump's speed to see if we could recreate certain phenomena at the operating limits, but the test installation did not function properly and we were not able to fulfill this goal of the test," he said.

SEP's third-stage testing is being performed in simulated altitude conditions on the PF41 test stand at the company's Vernon, France, facility (AWST Oct. 27, 1986, p. 53).

A second altitude simulation test cell at the Vernon facility has been readied to support the Ariane third-stage engine testing. □

terials processing—to avoid duplication of facilities.

In the transportation and communications areas, the U.S. has proposed the space shuttle as the baseline launch and return system and the Tracking and Data Relay Satellite or its follow-on as the primary communications system. The U.S. would allow other transportation and communications systems belonging to its partners to be used, if they are compatible with the station.

NASA is continuing to delay the request for proposals for U.S. station hardware development contracts. A total of \$150 million in Fiscal 1987 funds has been reserved for these contracts. Because it is beginning to appear that NASA will not be able to award the contracts until Fiscal 1988, congressional support is expected to develop soon for redirecting those funds toward the purchase of expendable launchers, according to a congressional official. □

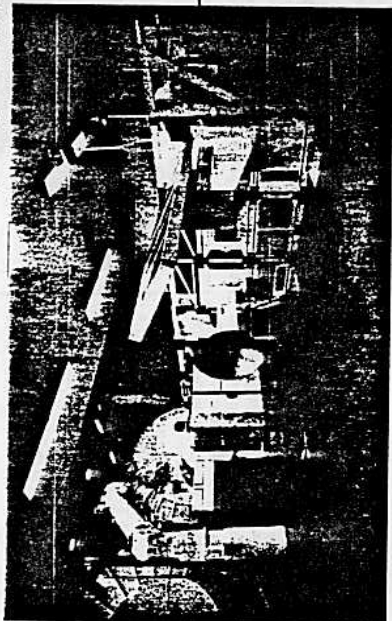
Beyond the cost of maintaining their own elements, the partners are expected to share with NASA "the costs attributed to the operation of the space station as a whole." The portion each partner is expected to pay would be equivalent to its percentage of resource use, which the U.S. apparently has established based on the percentage of the overall station each partner's contribution represents—for example, the ESA contribution previously has been estimated to be 15%, Japan 7.8% and Canada 3%.

In the new proposal, the U.S. abandoned altogether the concept of functional allocation, under which each module would be assigned a function—for example, life sciences, space technology or na-

U.S. draft, the partners will be expected to pay the full costs of operating and maintaining their elements, even though they will be allocated only a portion of the user time within them.

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In the new proposal, the U.S. abandoned altogether the concept of functional allocation, under which each module would be assigned a function—for example, life sciences, space technology or na-



Security Decision Directive is being developed that specifies station purposes and provides guidelines on the NASA/Defense relationship for station, a U.S. official said.

The partners are concerned about the vague wording in the NASA proposal. But one European official said Europe would find it acceptable if given greater control over station management. European officials believe that "peaceful uses" of the station is an impossible term to define in advance. But if military use required approval by the multilateral board on a case-by-case basis, there would be no need for a definition. Instead, military uses of the station could be classified peaceful or nonpeaceful through consensus, he said. This mechanism for determining Defense Dept. station access is not likely to be accepted by the U.S., however.

The draft also gives the U.S. the right to object to station uses or users sponsored by the partners on foreign policy or national security grounds. The partners also will be able to raise objections on those grounds to use of their respective elements.

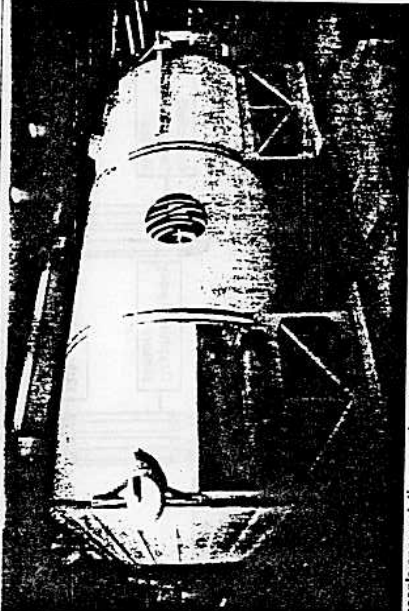
The Europeans continue to be concerned over the proposed assignment of station operating costs, although the latest proposal represents a great deal of progress, one official said. According to the

The proposed language would allow the U.S. to use station elements, both its own and those provided by the partners, "for any purpose, including national security purposes," as long as they are consistent with safety provisions, according to a draft intergovernmental agreement obtained by AVIATION WEEK & SPACE TECHNOLOGY. That language alone would not limit Defense Dept. use of the station strictly to research and development.

NASA officials, however, recently told Congress that the space agency and the Air Force have agreed that the station will not be used for weapons. NASA Administrator James C. Fletcher said that research on weapons components would be allowed on the station but "we could not put a major Defense Dept. weapon on the space station and have it acceptable to our foreign partners. The only conceivable Defense Dept. use is for research and the language [of the agreement] really reflects that."

Despite that assertion by Fletcher, Air Force and NASA officials said no separate agreement between NASA and the Defense Dept. exists to establish guidelines for military use of the station, other than the very vague language in the intergovernmental agreement. Within the National Security Council and the Senior Interagency Group on Space, a National

Japan Completes Mockup of Station Module



Japan's space station experiments module mockup just completed at the Tsukuba Space Center north of Tokyo illustrates the commitment Japan has made to the U.S./international station program. The experiments module (above) would house materials processing, space science, life sciences and other research. The 33 x 13-ft. module would be launched by the space shuttle. Later, the shuttle or Japanese H-2 booster would launch the 26 x 6-ft. exposure platform (right, top) that would be docked to the outside of the module. Various sensors could be exchanged on the exterior platform by the Japanese manipulator arm, shown near the module at left in the photo. The Japanese module interior (right, bottom) resembles the inside of the European Spacelab module.

modules is the most contentious one. Unless a compromise position can be reached, this issue could be the breaking point for international negotiations, a European space official said.

NASA has proposed that the station be managed by a multilateral board that would plan and coordinate operations. As board chairman, NASA would make decisions on issues where "it is not possible for the cooperating agencies to reach consensus," the NASA proposal said.

While the partners do not object to the concept of a management board, they do not want to relinquish final authority for control of their own elements.

European officials insist on retaining control over the Columbus pressurized module and the two platforms that Europe plans to contribute to the program. They believe that management decisions must be categorized into different levels. They agree that NASA should have ultimate authority in emergencies, where rapid judgments must be made. On other decisions affecting the station, they believe consensus management must be used. In areas where no consensus can be reached, no action should be taken, a European space official said.

A second key area of difficulty continues to be Defense Dept. access to the station.

Navstar Fire

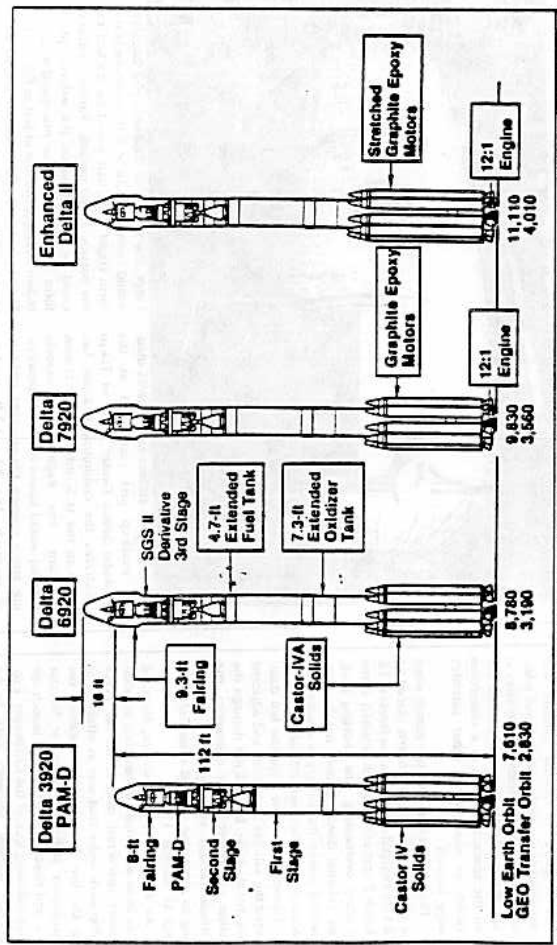
Los Angeles—A Navstar satellite was damaged during testing at Rockwell International Satellite Systems Div. facilities in Seal Beach, Calif., when a fire broke out on the spacecraft while in a cleanroom facility in which three other satellites were located.

The incident occurred last month when a shorting plug was improperly placed on a fully charged battery on the Navstar 15 Block-2 spacecraft, which resulted in the battery overheating. The shorting plug, an external device, should not be connected unless the battery is discharged, according to Rockwell officials.

Flames and smoke from the fire damaged the satellite's batteries and adjacent electrical wiring, but did not damage the other spacecraft in the cleanroom, the officials added. Investigation is continuing to determine the full extent of damage to Navstar 15.

As a result of the incident, Rockwell has been authorized to complete an additional spacecraft despite an Air Force stop-work order that was in effect prior to the fire. Rockwell had received the temporary stop-work order for Navstar 17 and beyond as a result of launch delays following loss of the Challenger. Production Navstar satellites were to be placed in orbit by the shuttle.

McDonnell Plans Rapid Buildup Of Delta Launcher Fleet



Four versions of the McDonnell Douglas Delta expendable launcher are shown above, ranging from the current Delta 3920 to a possible Enhanced Delta 2 booster, which would be capable of placing an

By Bruce A. Smith

Las Angeles—McDonnell Douglas plans a rapid buildup of the medium launch vehicle (MLV) program to a rate of 18 flights per year by 1991, although the company may use a supplementary Delta propulsion system to support commercial customers during the late 1980s.

McDonnell Douglas Astronautics Co. plans to have a launch capability of 12 vehicles per year by 1990 for Air Force Navstar satellites, National Aeronautics and Space Administration scientific payloads, and commercial customers. The launch rate would be supported by production facilities in Huntington Beach, Calif., and Pueblo, Colo.

The Astronautics Co. and the Air Force, however, are discussing the possibility of taking engines similar to the Rocketdyne RS-27 out of storage to provide additional launch opportunities for commercial customers.

The plan is partly the result of Rockwell International's Rocketdyne Div. not being able to increase production of the RS-27 Delta first-stage engine as fast as McDonnell Douglas can accelerate pro-

duction of the Delta vehicle, according to McDonnell Douglas officials.

The MLV program was intended primarily to launch Navstar global positioning system (GPS) satellites for the Air Force beginning in about 30 months, but Astronautics has three Strategic Defense Initiative payloads scheduled for launch through 1989, a NASA scientific payload to be placed in orbit in early 1989 and launch reservations with four companies for five payloads.

McDonnell Douglas has scheduled one commercial launch by the end of next year, and up to four in 1989.

To add early launch capability for commercial payloads, Astronautics is looking into use of MB-3 Block-3 engines from the Thor program in storage at Norton AFB, Calif. The MB-3 engines have sea level thrust of only 172,000 lb. compared with 207,000 lb. for the RS-27, but the MB-3 when combined with upgraded Castor 4A solid rocket motors will provide performance equivalent to a standard Delta 3920 booster.

The production line for the RS-27 at Rocketdyne was shut down for about three years beginning in September, 1983,

as expendable launch vehicles were phased out and payloads were consolidated on the space shuttle manifest.

Tooling for the RS-27 was taken out of storage and the line reopened late last year. In addition to the normal delays associated with restart of production, RS-27 engines have been built in the past using available H-1 engine components from the Saturn IB program. There are only enough H-1 components available to build four more RS-27s.

As a result, Rocketdyne will have to qualify new suppliers and subcontractors to build some RS-27 systems, and may have to conduct a hotfire test program. Meanwhile, McDonnell Douglas has given Rocketdyne a contract to begin work on long lead items such as castings and forgings and some completed high-cost items such as thrust frames.

Rocketdyne is working on four engines for the three SDI launches and the single NASA payload at a rate of about one engine every three months, with the initial delivery scheduled for next December.

The next engine in line will be the first RS-27 for the MLV program. Typical production rate prior to shutdown of the RS-

27 line was one engine per month, although Astronautics has asked Rocketdyne to study the possibility of raising production levels to 14 engines in 1990 and 18 in 1991.

The Rocketdyne-built MB-3s are candidates for use with some of the payloads because they would require little modification of the Delta when being installed. Rocketdyne said 101 of the engines have been used on Delta.

Two of the engines at Norton were delivered to the Air Force in 1979 and should not require much preparation for launch, while the other three units were delivered in the mid-1960s and would require modifications such as changeout of a lubrication system.

Near-Term Requirements

Louis C. Raburn, director of Delta programs at Huntington Beach, said the possible development of the MB-3 powered boosters, which would be designated 4920, is part of an effort to satisfy near-term launch requirements while continuing to develop more powerful boosters for the Air Force. Ultimately, the company would prefer to settle on a single design.

"We would like our production line to merge on a single configuration as quickly as possible for production efficiencies as well as schedule enhancement," Raburn said. "There will be an overlapping of these configurations for upwards of a year, but we then would hope to merge into a Delta 2 configuration that would meet all of our customer requirements."

Delta Versions

Delta versions McDonnell Douglas is offering, planning or considering development include:

- Delta 3920 with nine Castor 4 strap-on solid rocket motors and a payload assist module (PAM-D) capable of placing 7,610 lb. in a 28.5-deg.-inclination, 100-naut.-mi. low Earth orbit from Cape Canaveral, or 2,830 lb. into geosynchronous transfer orbit.

- Delta 4920 is a possible version using the MB-3 engine instead of the RS-27 with Castor 4A solid rocket motors. Performance would be comparable to the Delta 3920.

- Delta 5920 will be used for launch of NASA's cosmic background explorer (COBE) satellite into a 560-mi. orbit from Vandenberg AFB, Calif., in early 1989. The spacecraft, originally intended for launch from the space shuttle, will be reduced in weight from 10,500 lb. to 5,000 lb. and in size from a 15-ft. to an 8-ft. diameter. The 5920 will be a standard

Delta with short tanks and the same upper stage, but will use the upgraded Castor 4A motors. The COBE spacecraft is the only mission identified for a 5920 vehicle to date. The Delta 5920 will have the capability of placing a payload of 8,485 lb. in low Earth orbit and 3,100 lb. in geosynchronous transfer orbit.

- Delta 6920 will be developed for initial Navstar satellite launches. One of the changes for the 6920 will be an enlarged payload fairing section from 8 ft. to 9.3 ft., for an increase in payload diameter from 86 in. to 100 in. Other changes include a 12-ft. total stretch in the fuel and oxidizer tanks and higher thrust for the nine Castor 4As with upgraded propellant and changed grain shape. The 6920 is designed to place a payload of 8,780 lb. into low Earth orbit and 3,190 lb. into geosynchronous transfer orbit. Final two of four qualification firings for the Castor 4A motors are expected to be completed within 12-14 months.

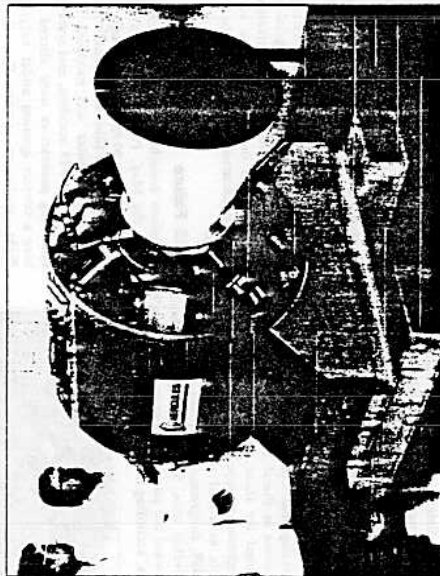
- Delta 7920 will launch heavier Navstar satellites beginning with the 10th GPS spacecraft. Additional performance will be achieved through use of graphite epoxy motor cases developed and built by Hercules, with propellant and grain similar to the Castor 4A.

lar to the Castor 4A, and a increased expansion ratio on the main engine exhaust nozzle from 8.1 to 12.1. Weight savings achieved through use of the composite cases on the nine strap-on motors will total about 17,000 lb. The 7920, which would place 9,830 lb. in low Earth orbit and 3,560 lb. in geosynchronous transfer orbit, would be phased in during early 1990.

- Enhanced Delta is a possible upgrade being studied by Astronautics and the Air Force that would have a 6-ft. stretch of the composite solid rocket motor cases to place 11,110 lb. in LEO and 4,010 lb. in GEO. Astronautics will be studying this version early this year before making a decision on whether to proceed with the motor case stretch. The new model, designated 8920, probably would take the place of the 7920 and would be available in about the same time period as the 7920—late in the first quarter or early in the second quarter of 1990.

Air Force launches are scheduled to begin at Cape Canaveral in October, 1988, at a rate of seven per year. In addition, McDonnell Douglas plans to have a total launch capability of 12 vehicles per year by 1990 and up to 18 by 1991. □

Hercules Casts First Small ICBM Third-Stage Motor With Propellant



Full-scale mockup of the third stage of the small intercontinental ballistic missile is shown at Hercules facilities in Utah. Hercules, which received a full-scale development contract for the SICBM, has cast the first motor with propellant.

Arms Control Protests Force Delay In Next Stage of SDI Research

By Paul Mann

Washington—President Reagan has postponed a decision on the test-and-develop phase of antimissile research, bowing to official arms control protests here and abroad that the Administration is risking abrogation of the 1972 Anti-Ballistic Missile Treaty.

The delay in where to steer the research could last weeks, months or years, pending further Administration consultation with Congress and the allies. At issue is how the Administration is going to administer Strategic Defense Initiative research in concert with the ABM treaty, which bans testing and development as well as deployment of nationwide U.S./Soviet missile defenses, whether sea-based, air-based, space-based or mobile land-based.

The Administration insisted last week that early deployment is not the issue before the President, but rather testing and development.

There have been suggestions here that the Administration might be positioning itself for a unilateral shift soon to the broad, more permissive interpretation of ABM testing and development that it theorized 16 months ago, but held in abeyance. The threat that the Administration was about to make that shift helped fuel the latest outcry over the risks SDI poses for the ABM treaty's survival.

The protests have drawn strength from other developments. These included Defense Secretary Caspar W. Weinberger's provisional endorsement in January of prompt phase-one deployment of an antimissile defense. His thinking became known shortly before congressional suggestions that an incipient shift was underway from long-term to near-term technology in the SDI program (AWST Feb. 9, p. 24; Jan. 19, p. 22). Speculation about gearing up SDI also has been fed by indications that research is progressing faster, and appears more promising, than expected (AWST Feb. 9, p. 24).

Administration officials are weighing what the White House calls a different pattern or configuration of SDI testing. They believe more advanced forms of testing and development are permissible under the Administration's broad, but belated and unilateral, interpretation of the ABM treaty. The State Dept. first tabled the permissive construction in 1985, only weeks before President Reagan's first summit in Geneva with Soviet General Secretary Mikhail S. Gorbachev. SDI proponents are arguing, however, that it has been the Soviets' political drive to confine U.S. ABM research to the laboratory that has made salient the distinction between broad and narrow.

The broad interpretation holds the treaty to be ambiguous enough to permit divergent interpretations of permissible testing and development. This reading stemmed from the State Dept.'s 1983 review of the secret negotiating record and what it revealed about the interpretations that the negotiators originally assigned to the treaty text 15 years ago.

When the broad interpretation became known in 1985, the Administration assured Congress that for the time being SDI would be confined to research within the framework of the strict traditional interpretation (AWST Sept. 1, 1986, p. 45; Nov. 18, 1985, p. 15).

Secretary of State George P. Shultz told a House subcommittee last week that the Administration had reopened the examination of the treaty's history, extending its reach beyond the negotiating record to the Senate ratification record and pertinent case law. The renewed examination is being made by Abraham D. Sofaer, State Dept. legal adviser, who performed the 1985 study. On Capitol Hill, Sen. Sam Nunn (D-Ga.), chairman of the Senate Armed Services Committee, is making an independent review of the negotiating record that he intends to conclude within days.

Further Insight

Concerning early deployment options, Shultz last week cited Defense Secretary Caspar W. Weinberger's assertion that there will be no technical basis for a decision this year or next.

Shultz offered further insight into current Administration thinking, however, saying progress in SDI research had been such that it had become useful to ask, "in a sense as a research question, how would you go about deployment if you decided to do it. That's what's caused all of this discussion, the fact that that question needs to be raised."

Deploying a strategic defense all at once is inconceivable, Shultz testified, so the issue becomes how to characterize sequential phases of deployment such that each phase by itself would lend stability to the U.S./Soviet military balance.

Because the phases are intended to culminate in an overall system, he added, "you don't want to start [deployment] until you have a clear, confident idea of where you're going. That's the kind of thing that's come out of asking that [research] question and that's where we stand."

The White House joined Shultz in playing down Weinberger's January call for early deployment. "The issue before the President is not one of deployment," White House spokesman Martin M. Fitzwater told reporters last week. "That has been used a lot by cabinet officers and government officials and others, and it has tended to lead the story in directions that it's not really going. Rather, the President is now considering the proper configuration of our research and development testing program. So the issue is...should we change the research and development program in a way that will make it subject to the broader, legally correct interpretation?"

Nunn, a possible presidential candidate in 1988, warned the President not to terminate U.S. compliance with the traditional interpretation. "Unless there is a consensus in Congress and the North Atlantic Treaty Organization that such action is warranted, Nunn said, termination would trigger intense political reactions in Europe and NATO and cause far deeper congressional cuts in SDI funding than might otherwise occur."

"Such a decision would also very likely be taken on Capitol Hill as the end of arms control under your Administration," Nunn said. "Finally, I am concerned that absent due consultation, a unilateral executive branch decision to disregard the interpretation of the treaty which the Senate believed it had approved when the accord was ratified in 1972 would provoke a Constitutional confrontation of profound dimensions."

This language drew a partisan rebuke from a Republican presidential prospect, Rep. Jack F. Kemp (N.Y.), an SDI advocate. "While you are debating technology, the Soviets are deploying strategic defenses," Kemp wrote Nunn, asking: "Where was the hue and cry about the Senate's [treaty ratification] prerogative when the Administration made the unilateral decision to abide by the SALT 2 treaty for five years—a treaty the Senate had refused to consent to ratify?" □

Japan Plans Lunar Mission in 1990

Innsbruck, Austria—Japan is preparing a lunar mission for 1990 that will allow the country to practice swingby techniques that could be used for future flights to the Moon and planets.

The cylindrical spin-stabilized Muses-A Japanese spacecraft is expected to be launched in early 1990 by an MU-3S2 vehicle for a one-year period of maneuvers around the Moon. A miniature satellite mounted atop Muses-A will be separated and injected into a lunar orbit before the main spacecraft makes its initial swingby.

Commission Approval

Details of the mission were outlined at the International Astronautical Federation's 37th congress here last year. The mission is being developed by Japan's Institute of Space and Astronautical Science (ISAS) and has been approved by the country's Space Activities Commission.

The Muses-A spacecraft will weigh 195 kg (430 lb.), including 12 kg (26 lb.) for the miniature lunar orbiter. Solar cells provide the necessary operating power of about 100 w. Diameter of the spacecraft is 1.4 meters (4.6 ft.), and its overall height of 0.85 meter (2.8 ft.) includes the top-mounted lunar orbiter.

Muses-A's spin axis will be maintained almost perpendicular to the orbital plane throughout the mission to provide the proper spacecraft orientation for thermal and power management and for communication with the Earth. Attitude and orbital control is provided by eight 23-Newton thrusters and four 3-Newton thrusters.

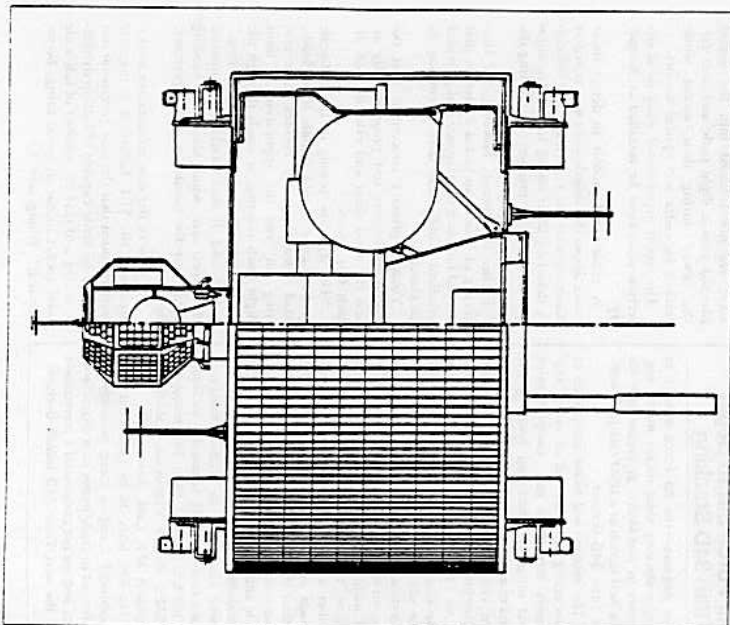
Muses-A will employ an X-band downlink for the first time on a Japanese spacecraft. An S-band communications package also will be carried on the satellite. Packet telemetry and Real-Solomon coding experiments will be performed using a new fault-tolerant computer, program officials said.

An optical navigation experiment will verify the use of such a system on a spinning spacecraft. Data from observations of the Moon's fudge and of bright stars will be processed on board and compared with orbital determinations computed on the ground.

Particle Dust Counter

Muses-A may be fitted with a West German particle dust counter to measure the mass, momentum and crude flight direction of micrometeoroids that strike the spacecraft. The device would be supplied by the Munich Technical University and uses large surface piezoceramics.

The spacecraft's trajectory is being designed to provide the maximum number of lunar swingbys within Muses-A's one-year lifetime.



Japan's Muses-A spacecraft is detailed in this drawing, the right half of which is a cutaway to show the interior layout. The basic cylindrical spacecraft is 1.4 meters in diameter. Mounted atop it is a polyhedral-shaped orbiter that will be separated from Muses-A and placed in lunar orbit.

Launch of Muses-A from the Kagoshima Space Center is scheduled during a 20-day window in January-February, 1990.

The first lunar swingby is planned on Mar. 20, 1990, with the closest approach to the Moon made at a distance of 22,700 km (14,100 mi.). Prior to the lunar pass, Muses-A will release its small orbiter for injection into orbit around the Moon.

Muses-A will reach an apogee of about 1 million km after the fifth lunar swingby, which will occur on Aug. 6, 1990, and this apogee distance will be maintained during the rest of the spacecraft's operational lifetime, officials said. A Sun-synchronous orbit has been set as one of the mission requirements to allow the spacecraft to explore the global or geofront regions periodically. This will enable Muses-A to serve as a test flight for a future ISAS mission called Genail,

which Japan is planning as part of the multinational International Solar Terrestrial Physics (ISTP) program.

Muses-A will be equipped with one medium-gain and two low-gain antennas. The collinear array medium-gain antenna will receive the S-band uplink and will transmit telemetry in S- and X-band, while the two cross-dipole omnidirectional low-gain antennas are used for S-band uplinks and downlinks.

The polyhedral-shaped lunar orbiter satellite that is to be separated from Muses-A has a cross section of about 30 cm (14 in.) and is covered with indium phosphorous solar cells. The orbiter's radio motor accounts for 5 kg (11 lb.) of the spacecraft's 12-kg weight. An S-band cross-dipole omnidirectional antenna atop the orbiter provides a direct link to the mission ground station. □

New Factors Cited in Challenger Accident

By Craig Covault

extensive analysis of the wind shear and booster attach ring issues, Rodney said. The external tank/attach booster ring wraps around the solid motor just below the aft field joint that failed. The ring is connected to the external tank by

three struts. In several launches before the Challenger accident, technicians at Kennedy Space Center found that several bolts in the attach rings of recovered boosters had broken off, Rodney said. United Space Boosters, Inc., and Mar-

Washington—Evidence is building that loss of the space shuttle Challenger occurred not only because of a defective booster, but also because of undetected wind shear and a weakened attach ring that holds the boosters to the shuttle's external tank, according to Astronaut Office Chief John W. Young.

"This new evidence supports the many other clues that show the catastrophic solid rocket motor failure was a complex dynamic failure at 58.8 sec., and not at liftoff," an internal memo written by Young said.

"The evidence of solid rocket booster external tank attach ring failures is new data. The potentially high vertical wind shear is new data," Young said in his memo, which was sent to George W. S. Abbey, head of flight crew operations at the Johnson Space Center.

New evidence concerning the attach ring raises questions about whether several other missions actually flew with potentially significant weakened booster attach structures as well as the flawed booster joints.

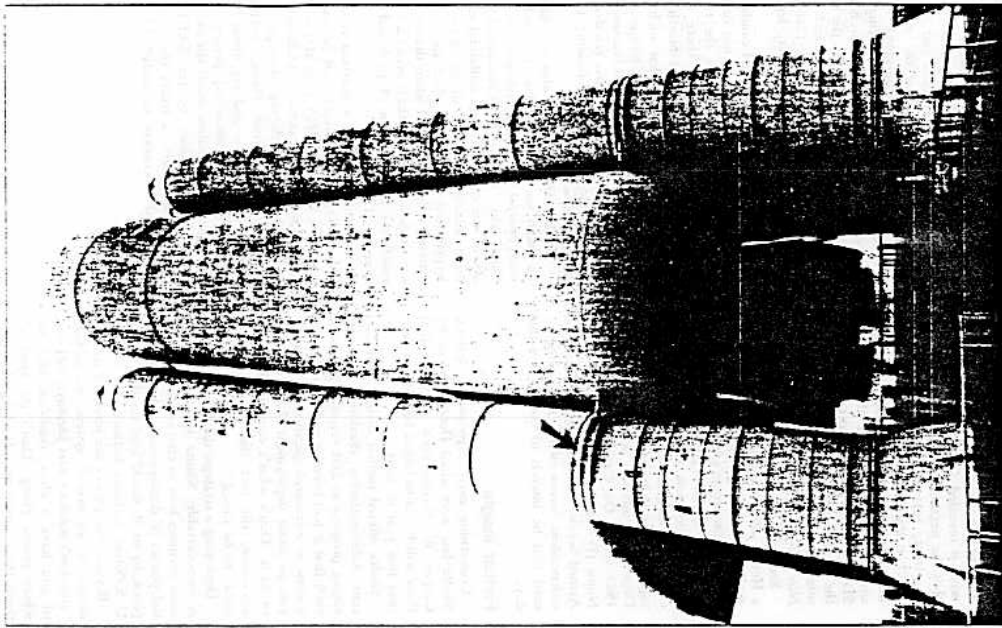
AVIATION WEEK & SPACE TECHNOLOGY obtained a report prepared two years before the accident, raising concerns about Kennedy Space Center wind shear detection and stressing its importance for safe shuttle launches.

The 1984 wind shear report, prepared by National Oceanic and Atmospheric Administration scientists, said, "NASA should strongly consider the use of a wind profiler at Kennedy to support shuttle launches.... It is vital to ensure that the wind profile structure does not cause [shuttle] structural loads beyond those established as allowable for launch."

Young noted that while the failure sequence began with the booster puffing smoke at liftoff, the ultimate rupture in the joint involved far more dynamic factors at altitude that must be considered in the test program.

Young has recommended more extensive dynamic booster ground testing than currently is planned before the shuttle returns to flight. If followed, the recommendation could further delay the shuttle's return to flight status.

"Unless NASA conducts the best possible all-up, full-scale dynamic tests, we may learn from another sad experience that we have not fixed the complete problem correctly," the Young memo said. NASA's new Office of Safety also is concerned about the new data, according to George A. Rodney, who heads the office. Rodney was becoming interested in the attach ring issue before Young's memo. The Safety Office will conduct an



Shuttle booster/external tank attach ring (arrow) is being evaluated as a possible new factor in the Challenger accident. New data indicate the United Space Boosters ring may have been weakened during liftoff. This could have been a factor in connection with unusually severe wind shears. It is also possible, however, the bolt problems detected on several other missions could have been caused by water impact of the reusable boosters.

shall Space Flight Center, both of which are responsible for the attach ring, earlier believed the bolt failures resulted from water impact. But new data indicate the bolt shearing could have resulted from liftoff loads and that several missions may have flown ascents after breaking attach ring bolts at liftoff. The Safety Office investigation will try to determine whether water impact or liftoff loads are the cause of bolt failures.

"The final Mission 51-L failure appears to have resulted from damaged [booster] seals reopening at 58.8 sec., [a process] potentially aided by a weakened external tank attach ring reacting to loads from a significant vertical wind shear," Young said.

Negative Safety Margins

"Very recently United Space Boosters, Inc., and Marshall have discovered negative margins of safety in the solid rocket motor external tank attach ring. These have resulted in at least 22 solid rocket booster external tank attach systems having bolt shear failures."

"The largest negative margins of safety in the external tank attach ring occur at liftoff, according to the analysis," Young said. "It seems probable that the liftoff failures of bolts in the external tank attach ring would allow greater joint rotation in the aft field joint."

Rodney said the bolts found broken on flights before Mission 51-L join a series of frames that make up the external tank/booster attach ring.

Young believes that if the bolts broke at liftoff of Mission 51-L, the ring would have weakened, introducing unexpected dynamics in the booster, especially as the vehicle encountered unexpectedly high wind shear above Kennedy. That, in connection with the damaged seals, would have prompted a sequence of events that must be fully evaluated in the test process, according to Young.

Other investigators also now believe there was a complex wind shear pattern above Kennedy Space Center that may have exceeded allowable launch criteria but which U.S. Air Force meteorologists at Cape Canaveral were unable to detect.

"We recently received a report that two upper-level jet streams were located together over the Florida peninsula at the Mission 51-L liftoff time," Young's memo said. He quoted from the American Meteorological Society Journal, which published a detailed study of the wind conditions above Kennedy on launch day. This report "suggests that the wind shear encountered by the shuttle could have been larger and more concentrated in a narrower zone than measured by radiosonde," only about 6 min. after the accident.

"The [Meteorological Society] report also notes that the data analysis suffers

from potentially inadequate vertical resolution, which could lead to an understatement of the magnitude of the vertical wind shear," Young said.

Young also noted that the wind shear data are supported in part by data showing Challenger's solid rocket boosters were steering in an attempt to maintain the ascent trajectory as the vehicle's flight control system sensed the wind shear. "It is possible that the [booster] global motions could not accommodate all the wind shear," Young said.

Other independent wind investigators have begun to raise similar concerns, and are receiving assistance from NASA in their work to assess the role of wind shear in the accident.

University of Wisconsin researcher William P. Birkenmeier, who has specialized in wind analysis for 20 years, wrote the Rogers Commission last March that shear appeared to be a significant element in the accident, based on his analysis of conditions above the Cape during liftoff.

The Cape Canaveral balloon data taken before and after the accident showed no significant shears, but analysis of satellite images of clouds in the vicinity showed

Air Force Set to Begin Titan 34D Stacking

Los Angeles—The Air Force expects to begin stacking solid rocket motor segments in mid-March in preparation for the next launch of a USAF/Martin Marietta Titan 34D booster.

The decision will follow completion of processing of a full set of motor segments through a new, comprehensive test program established following the loss of a Titan 34D last April when one of the vehicle's solid rocket motors failed after liftoff from Vandenberg AFB, Calif.

Air Force officials said a decision on stacking operations could be delayed if the site of the next Titan 34D launch—Vandenberg or Cape Canaveral—is not known by the time testing on the first set of motor segments is complete. In that event, stacking would be delayed until either a final launch site decision was made or a second set of solid rocket motor segments had been cleared about two months later.

In addition to nondestructive testing at Vandenberg and Cape Canaveral, the Air Force also plans to conduct firings of solid rocket motors segments—including a full 5.5-segment Titan 34D motor—at USAF's Rocket Propulsion Laboratory, Edwards AFB, Calif., next month.

The RPL tests, to be conducted on a modified F-1 engine stand, primarily are intended to study motor joint characteristics and are not considered a prerequisite to the next Titan 34D launch decision.

considerable activity, Birkenmeier noted last March.

Birkenmeier now is completing an analysis that uses wide-angle photography of the smoke trails of falling Challenger debris to further assess the wind conditions. NASA is supplying him with data and expects to use his findings in simulator runs at the Johnson Space Center to learn how such winds could affect a climbing shuttle vehicle. Birkenmeier is working with astronaut USAF Col. Brewster H. Shaw in this area.

The smoke trails were bent by shears of different intensity at various altitudes and indicate there was a far more severe and complex wind shear environment over the Cape than the balloon data or Rogers Commission investigation indicated, Birkenmeier said.

Measurement Technique

The 1984 NASA wind study warned that the method of wind shear measurement used at Kennedy had limitations. The NOAA scientists who prepared the report noted that the balloons used at the Cape are not released into the actual planned vehicle flight path, and drift farther away during their ascent while tracked by radar and optical sensors. The report urged better wind shear detection equipment be installed at Kennedy.

A radar wind profiler to detect shear zones above the shuttle pads was tested at Kennedy after the report, but had difficulty detecting shear owing to aircraft, automobile and other interference affecting the sensitive equipment.

Earlier this month, however, the University of Wisconsin tested a profiler that filtered out such interference and provided excellent wind shear data, according to Birkenmeier.

Young's primary concern is that the upcoming booster test program fully assesses the wind shear and external tank attach ring issues.

"The dynamic testing of the full-scale rocket motor should include liftoff loads, load release, twang, booster structural 'ring out' and the application of limit flight loads reacting to winds through the redesigned external tank attach ring," Young said. It also should accommodate the worst-case wind shear or bending loads that the booster would experience, he said.

"In view of the new information associated with the 51-L failure, it is urgently recommended that the new horizontal test facility be made capable of full-up dynamic testing and that the number of full-scale solid rocket motor dynamic firings be increased," Young said. □

Houston Power Company Invests in Space Services, Inc.

Washington—Space Services, Inc., the Houston-based private launch vehicle power company, Houston Industries, Inc., which recently formed a venture capital subsidiary to invest in SSI and other projects.

One analyst said he expects SSI to receive a large infusion of cash, perhaps as much as \$30 million, if the subsidiary, Development Ventures, converts warrants it has purchased into SSI majority ownership. The new capital would enable rapid development of the Constellation launch vehicle by SSI, and fuel intense competition between SSI and American Rocket Co. (Amroc), both of which hope to break into the small payload launch market this year.

The Canadian investment banking firm McLeod Young Weir, Inc., recently agreed to work with Amroc to raise capital for its small expendable booster, the Industrial Launch Vehicle (AWAST Sept. 29, 1986, p. 18).

The market for small payloads is relatively undeveloped, with possible launch demand coming from the Strategic Defense Initiative, the oil and Earth resources industries and news organizations that hope to orbit reconnaissance satellites. Other possible users are the Air Force Space Technology Center, NASA and intelligence agencies, which recently have shown increased interest in using small launchers to orbit small surveillance satellites.

Hybrid Engine Design

Amroc has been testing its new hybrid engine design at the Air Force Rocket Propulsion Laboratory, but has yet to fly a space mission. A suborbital test launch, carrying no payload, is planned in late 1987.

Amroc is expected to launch its first orbital mission in 1988 with a Defense Dept. payload and may announce in the next few months a cooperative agreement with the Defense Dept. for several missions.

George Koopman, American Rocket president, said the company has raised more than \$1 million in private financing to date and needs to raise a total of \$10 million before the development program is complete.

American Rocket's Industrial Launch Vehicle and Space Services' Constellation will be able to launch 3,000 lb. payloads to low Earth orbit, according to the companies. However, Amroc officials claim that the ILV will be able to do the job for about half the \$15 million Space Services

By Theresa M. Foley

Washington—Space station officials are becoming increasingly concerned that the program will be delayed for several months due to White House inaction on new cost estimates, which have reached \$21 billion in real-year dollars.

At the same time, support is growing among some members of Congress to replace the permanently manned station concept with a man-tended platform for the early years. Other members are threatening to withhold \$767 million in station funding for Fiscal 1988 because NASA officials, who are under orders not to discuss the estimates, have not explained the changes.

OMB Memo

Office of Management and Budget Director James C. Miller described the new cost estimates in a Feb. 10 memorandum to President Reagan as having reached \$14.5 billion in 1984 dollars, or \$21 billion in current-year dollars.

White House Science Advisor William R. Graham, who was acting NASA administrator at the time of the Challenger accident, has become increasingly skeptical of the station program, according to NASA and congressional sources. Graham is particularly concerned over the amount of damage the station will do to space science programs and budgets, they said.

Graham testified before a Senate panel last week that he is coordinating the

White House review of the station and will assemble a set of options to be presented to President Reagan. Graham said he would look at options forwarded by NASA and also develop other alternatives to give Reagan a choice of ways to proceed. Graham hoped to have the review completed "in weeks rather than months," but that the timing was up to Reagan.

Miller's memo was leaked widely to members of Congress and their staffs. While Congress has yet to be briefed on the cost increases and begin debating the station anew, several congressional aides said the option of building the station in incremental steps will be the probable response, rather than approving a \$21-billion package, as NASA would like.

Rep. Bill Nelson (D-Fla.), chairman of the House space science and applications subcommittee, last week threatened to withhold station funding if NASA does not inform Congress of details of the cost increases by Mar. 25, the date his subcommittee plans to mark up NASA's bill. "This committee is not going forward until the same illusions we had last year," Nelson told Andrew Stofan, NASA associate administrator for the space station, during a hearing.

Stofan said he had been ordered by NASA Administrator James C. Fletcher not to discuss details of the cost increases before the subcommittee because they were under review by the Reagan Administration. Nelson said the subcommittee would not take the lead in getting the station fully funded in Fiscal 1988, as it

GOES Launcher Procurement Debated

General Dynamics has decided to remain in the commercial launch vehicle marketing business despite losing to McDonnell Douglas in the U.S. Air Force medium launch vehicle competition. In addition to GOES, General Dynamics also is bidding to provide Eutelsat launch services.

The GOES launch vehicle decision has been debated between NASA and the Commerce Dept. because NASA traditionally has held standard government competitions for weather satellite boosters.

There has been an emphasis at the Commerce Dept. on a commercial competition to obtain the best price. A request for proposals from NASA for the launch services has been delayed by the commercial versus government competition decision.

did for Fiscal 1987 when the program received \$410 million, unless the subcommittee is fully informed. "The alternative is that the NASA authorization goes forward and there's not anything there for the station. If you don't have this commitment, fighting for you, there's going to be deep trouble," he said.

Congress approved the Fiscal 1987 funds on the basis of an \$8-billion program and with the understanding that hardware construction would begin this year.

"We asked time and time again about the \$8-billion figure," Rep. Robert Walker (R-Pa.), ranking minority member of the House space science and applications subcommittee, said. "At no time did NASA tell us this was an off-the-wall figure that NASA cooked up to give us some kind of guessing range."

Real Trouble

Walker, generally a strong space agency supporter, warned NASA Deputy Administrator Dale Myers last week that "the space station's in real trouble" because of the cost increases.

"In all honesty, I have yet to see sufficient justification to move forward with an \$8-billion station," Walker said. "We have yet to bend the first piece of metal for the station, and the costs have more than doubled. There comes a time when we have to start asking, what are we going to get for this investment, and does it make sense?"

NASA's space station contractors, who have been waiting since last August for the release of requests for proposals, are worried that the debate in Washington will result in changes detrimental to the program and its goals. NASA officials do not know when they will be able to issue the RFPs.

"We're concerned by political machinations that don't reflect the real engineering or business side of the equation," an industry official said. "The Administration is putting the station far down on the nation's list of priorities."

Fletcher told AVIATION WEEK & SPACE TECHNOLOGY that the contractors should be concerned.

"There's uncertainty about the leadership at the White House," he said. "I haven't got control of the decision, the White House has control."

Several industry officials said it appears that some White House staffers are determined to prevent a quick resolution of space station issues, effectively suspending the program.

"The White House has other things on

its mind, and it appears that the space station has no champion to move it through the approval process," a station industry official said.

Fletcher has informed the Administration that for hardware alone the estimates have increased by \$4.6 billion to \$10.7 billion, according to the Miller memo. Of those amounts, \$1 billion is needed to pay for changes in the design and assembly approach to the station, and \$3.6 billion is required for ground-based support infrastructure, such as test and operating facilities and simulators.

The reserve account has risen by \$2.5 billion to \$1.8 billion to provide for cost growth and uncertainties.

The \$14.5-billion level, which Miller said is Fletcher's recommendation, is \$2 billion lower than the highest internal NASA estimate, which came from the comptroller's office. Miller said the NASA estimate fails to include several essential items. Among the costs missing: ■ NASA has deleted \$600 million being used to define the station. Much of this already has been spent. ■ Station operating costs, estimated at a minimum of \$1 billion per year.

■ A lifeline for emergency rescue of astronauts, expected to cost \$1.2 billion. ■ Transportation costs to assemble, equip and deliver passengers to the station. ■ Science and technology experiments for the station would cost extra.

■ Elements that may be added later, for example to convert the station to a staging base for manned lunar or Mars missions.

In-Depth Analysis

Stofan explained to the space science subcommittee that the \$8-billion estimate came after only 0.1% of station funds were spent, and was not based on in-depth analysis. He attributed the increases to several factors:

■ The station program was forced to pay center support costs because of a change in accounting systems, adding \$1.5 billion.

■ A decision was made to contract for systems engineering work instead of keeping it in house, costing an extra \$500-750 million.

■ Basic hardware cost estimates grew by about \$1 billion.

■ The amount budgeted for reserves grew. Although Stofan would not supply the amount.

Walker tried to add the figures to reach the new \$15-billion estimate, but could not. "It sounds to me like we have the old shell game played on us here," he said. □

Soviet Space Science Missions Challenge U. S. Leadership

By Craig Covault

Cape Canaveral—The Soviet Union is preparing to launch a dozen or more large scientific space missions that will challenge U. S. space science leadership already eroded by budget constraints and the shuttle accident.

While several hundred million dollars worth of U. S. Space Shuttle science hardware sits idle at the Kennedy Space Center here, the USSR has ordered development of at least 10 new Earth orbit science payloads and two new missions to Mars.

One of the new Soviet Earth orbit spacecraft will unfold a 100-ft. radio astronomy antenna and at least four of the Soviet Earth orbit science missions are planned for launch this year. Coupled with additional activities on the Mir space station, the effort will provide Soviet scientists with more opportunity to conduct space research than their U. S. counterparts for at least the next two years.

Mir cosmonaut Yuri Romanenko and Alexander Lavekin last week began photography of the Caucasus Mountains to help in Soviet water runoff flood calculations. On Feb. 23 the crew separated the Progress 27 tanker from the station's air port, and the tanker on Feb. 26 was commanded into a destructive reentry.

Many of the new Soviet space science flights involve collaboration with West European nations as well as the Soviet bloc.

The overall effort represents "an impressive assortment of robot observation forces and scientific platforms that will equip the state of the art technologies," according to Soviet analyst Nicholas L. Johnson.

Johnson is advisory scientist for Ted J. Brown, Engineering, Colorado Springs, Colo., and participates in both U. S. Air Force and civil assessments of Soviet space capability.

The new Soviet Earth orbit science missions will include:

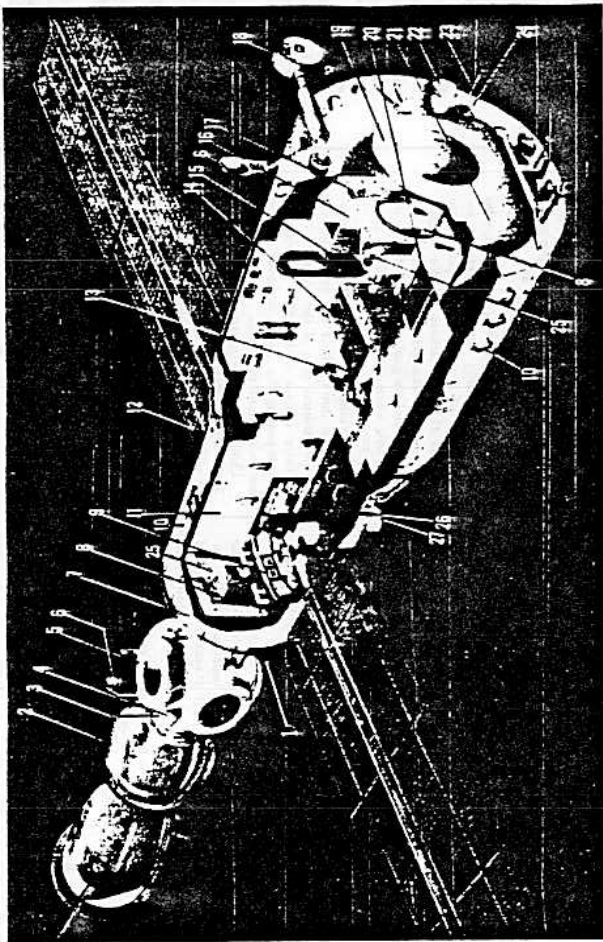
- **Aktiv-1K, 1987 launch**—This mission will involve both a primary

Soviet Mir space station will support multiple science, space applications and military technology development. Cosmonauts Yuri Romanenko and Alexander Lavekin this week will complete their first month on board Mir, shown here with a Soyuz transport docked to its forward port. A large astrophysics module will be launched soon and be attached at one of the side ports on the hub. The 42,000-lb. station will be enlarged to a 200,000-lb. facility by the addition of these modules. Mir features are: (1) base module, (2) Soyuz, (3) spacecraft interlock, (4) manipulator seat, (5) side docking ports, (6) approach system antenna, (7) work module, (8) work module hatch, (9) station control area, (10) handgrips, (11) removable interior panels, (12) solar panels, (13) bicycle exerciser, (14) work table, (15) individual sleeping compartment, (16) toilet, (17) washing facility, (18) radio satellite communications antenna, (19) aerial docking port, (20) treadmill exerciser, (21) intermediate chamber, (22) main entrance, (23) docking target, (24) instrument module, (25) hatch cover, (26) observation window and (27) window blind.

spacecraft and a subsatellite to demonstrate magnetospheric physics similar to some previous space shuttle tests. The mission is being managed by the Intercommiss organization that coordinates Soviet bloc space activities. "Ultrahigh frequency waves will be injected into the magnetosphere to measure their effects," Johnson said, in his annual Soviet Year in Space Report. The "Magion" subsatellite portion of the mission will use a vehicle similar to one used on the Intercommiss 18 flight.

- **Blasat, 1987 launch**—Two monkeys will be carried on this biological satellite mission. In addition, numerous rats and other small animals will be carried, Johnson said. The rats will be dissected following recovery of this Vostok type spacecraft to study changes in their systems following weightless exposure. The mission indicates the Soviets are maintaining a consistent level of flight activity in their life sciences program with annual missions every two years.

- **Gamma-1, 1987 launch**—This astro-



physics flight will use a 14,000-lb. vehicle modified from the Soyuz/Progress design. "The much delayed Soviet-French project will study both gamma and X-ray sources," Johnson said. The vehicle's 3,300-lb. telescope will use a complex package of detectors including 23 layers of spark chambers, followed by a set of scintillation counters, then two more spark chambers and finally a multilayer scintillator calorimeter, Johnson said.

- **Roenigen module, 1987 launch**—This 40,000-lb. astrophysics telescope module will be launched by a heavy Proton booster and docked to the Mir space station (AWA51 Feb. 16, p. 21). One Soviet and three West European instruments make up the primary observing system.

- **Earth resources module, launch 1987-88**—A 40,000-lb. Earth resources camera module is expected to be launched to dock with the Mir in late 1987 or early 1988.

- **Granat, 1988 launch**—Granat, a cooperative Soviet-French effort, will be a natural follow-on to the Gamma-1 and Roenigen platforms of 1987," Johnson

said. The Soviet satellite will carry a 2,200-lb. X-ray telescope. "Granat will also be the second use of the new heavy Astron type spacecraft designed to support major astrophysical programs for the remainder of the century," according to Johnson.

- **Interbol, launch 1988-89**—Launch of this Soviet-French project will involve four spacecraft. Two pairs of Progress and Magion spacecraft will be launched into different orbits for comparative magnetospheric studies.

- **Aedra, 1990 launch**—This 14,000-lb. Progress type spacecraft also will be a cooperative effort with France and will involve the study of submillimeter emissions from deep space monitored from a low Earth orbit.

- **Rascas, launch 1988-90**—This mission will involve automatic deployment in space of a 100-ft.-dia. radio antenna similar in design to the 33-ft.-dia. KRT-10 antenna deployed from the Salyut 6 space station in 1979, Johnson said. The spacecraft will conduct very long baseline inter-

ferometry (VLBI) experiments using ground-based telescopes in the Crimea.

- **Radio Astron, launch 1990-92**—This large spacecraft will deploy a 33-ft. radio antenna to detect radio emissions from deep space. European Space Agency participation is expected.

Another indication of a more aggressive Soviet space science effort is the reinvigorated Mars program. While shuttle schedule pressure has forced the U. S. to delay its Mars Observer mission from 1990 to 1992, the Soviets have decided to accelerate their most ambitious Martian effort from 1984 to 1992 (AWA51 Feb. 23, p. 17).

That Soviet mission, earlier designated "Vesta" in recognition of a planned flyby of the Vesta asteroid, has been redesignated "Mars." Its asteroid flyby has been dropped so attention can be focused on Martian surface operations. That will include deployment of camera-carrying French balloons. The balloon mission will follow the July, 1988, Soviet Mars/Phobos launch.

THE SUPERCONDUCTOR RACE HEATS UP

Electronics,
22 January

NEW YORK

In just a few short weeks, scientists the world over have accomplished what no one had been able to do in more than a decade of trying: produce a superconductor that can operate at temperatures higher than 23 K. In a spree that began in Zurich, researchers from Japan, the U.S., and, most recently, China have eclipsed that 13-year-old record, and new highs are being claimed almost weekly.

"I'm as amazed by this as anybody," says Robert Dynes, director of chemical physics research at AT&T Bell Laboratories in Murray Hill, N.J. "I find it absolutely astounding, [yet] one has to believe this is only the beginning."

The new advances began with the discovery that certain oxide materials can act as superconductors. Superconductivity eliminates electrical resistance and makes it possible to create very powerful magnetic fields. The materials therefore could eventually be used for high-speed interconnects on ICs and printed-circuit boards. The new superconductors were discovered last winter at IBM Corp.'s laboratories in Zurich, Switzerland. IBM's results, based on a compound of barium, lanthanum, copper, and oxygen, were announced last April.

FLOODGATES. In December, IBM's findings were confirmed by researchers at the University of Tokyo, who achieved superconductivity at 28 K. Since then, Bell Labs, the University of Houston, and IBM have all claimed records. Bell says that in late December its scientists developed a lanthanum strontium copper oxide compound that becomes superconductive at about 36 K. At the same time, the Houston team says, it achieved superconductivity at about 40 K by keeping its material under very high pressure. IBM will release a paper this week showing its latest results—superconductivity at about 39 K.



COOLING. Bell Labs' Bertram Batlogg prepares material for testing in a supercooled container. Collaborators are, from left, Edward Reitman, Robert Cava, and Robert van Dover.

And now, a group of scientists at the Institute of Physics at the Chinese Academy of Sciences in Beijing reports it has developed a material that reaches superconductivity at 70 K. The Chinese team's work is not yet fully documented, but if its results are confirmed, the breakthrough could have tremendous impact.

At that temperature, superconducting techniques would be far less expensive to implement. The eventual payoff could be huge for the semiconductor, computer, and telecommunications industries, as well as in high-speed rail travel, nuclear fusion, and power transmission. Raising the temperature at which superconductivity occurs makes cooling the material much simpler.

However, all the recent reports leave some researchers wary of a numbers race. "In this business you have to be very careful in measuring the temperatures and everything else," says Karl Alex Müller, one of the two IBM researchers who made the initial discovery. "At this moment, one should not be making too much of an issue over a difference of two degrees either way."

Critical to the issue, Müller says, is at what point researchers decide a material is becoming a superconductor. Although data is generally reported for the point at which superconductivity starts, he says, "it's not necessarily a sharp point." Also, it remains to be proven whether the new materials can be produced in thin-film form—which is essential if semiconductor and computer technologies are to use the materials.

If they can, superconducting interconnects linking ICs on computer boards could have significant advantages over optical interconnects, says AT&T's Dynes. Optical interconnects must be at least 1 μm in diameter, he explains, whereas electrical interconnects can be much narrower, conceivably as narrow as 100 Å.

"With these new materials, the way has been opened up for other oxides, which may be even better," Müller says. "The prospects are really good" that superconductivity can be achieved at even higher temperatures. —Tobias Naegele

"Wait a minute... wait a minute..."

you ain't heard nothin' yet!" — Al Jolson



SCIENCE NEWS of the week

21 February

Superconductive Barriers Surpassed

True breakthroughs are rare in science. But if recent work on superconducting materials at the University of Houston and the University of Alabama in Huntsville is confirmed, it may very well join that exclusive "breakthrough" club.

The research team, led by Houston's Paul C. W. Chu, has made a material that becomes superconducting at 98°K, or -283° F. This breaks the group's record of 52.5°K, set with another material just two months ago (SN: 1/10/87, p.23). Since superconductivity, or the loss of all electrical resistance, was discovered at temperatures around absolute zero in 1911, scientists have hoped to increase the temperature at which the phenomenon occurs so that it could be more readily used in practice.

The recent discovery is technologically important because it will enable scientists to use liquid nitrogen to get to

superconducting temperatures. At 77°K, liquid nitrogen is 10 times less expensive and 20 times more effective as a coolant than is the currently used coolant liquid helium, according to the National Science Foundation, which announced the find on Feb. 16.

With the new material, says Chu, a wide range of previously conceived applications becomes practical—including no-loss electric power lines, magnetically levitated trains, and very large magnets for medical magnetic resonance imaging. (Two weeks ago, a prototype "Maglev" train in Japan established a world record when it reached 400 miles per hour, according to the Feb. 12 NATURE.) At the moment, the material is too brittle to be made into wires, but Chu expects this problem to be overcome. If this is done soon, he says, the new material "will also surely have a great impact on the con-

struction of the [recently approved] Superconducting Super Collider" particle accelerator (see p. 119).

Chu's group had set its 52.5°K record by pressurizing a lanthanum copper oxide compound. In their most recent work, the researchers were able to mimic the effects of pressure by manipulating the chemical makeup and structure of the material. Chu says he cannot yet reveal the composition or structure of the new material, which is not lanthanum copper oxide, because a patent is pending. More information will become public, he says, when his group's papers are published in the March 2 PHYSICAL REVIEW LETTERS.

But even these papers may soon be outdated. Chu says his group has had a very preliminary indication that superconductivity may occur at 240°K. That number, says one scientist in the field, "just leaves me speechless." —S. Weisburd

INFATUATION WITH HIGH-PURITY MATERIALS MAY BE POINTLESS

The industry quest for ever-higher levels of purity in gases, chemicals, and solid materials is approaching "witch hunt" proportions, says Daniel J. Rose, president of Rose Associates in Los Altos, Calif. He says demand has pushed analytical measurement technology to the limits. Chip makers may well be seeking higher purity materials than they really need, Rose says. Although purity levels of better than one part per billion are required for many solid materials, in some cases customers are seeking purity levels as much as 10 to 100 times greater.

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TECHNOLOGY TO WATCH

A WAY TO REWRITE DATA ON MAGNETO-OPTIC DISKS

Researchers at Carnegie Mellon University have discovered a simple method for direct erasing and rewriting on magneto-optic recording media that makes possible the same high-speed direct read, write, erase, and rewrite capabilities as magnetic recording while retaining the very high density of magneto-optics. Until now, the absence of direct overwrite has kept magneto-optic disk drives from competing with magnetic drives, even though they can hold 25 times the bit density of the best magnetic disks.

Magneto-optic recording technology uses a combination of magnetism and laser optics to write a bit and pure optics to read it. That method of writing and rewriting, however, does not permit direct writing—changing a bit on the fly. The Pittsburgh university's team has discovered that the inherent demagnetizing field in the disks' magnetic media can be used to perform erasing and direct writing. The team successfully altered the media formulation to raise the compensation temperature and developed a read-before-write scheme. The technique looks very promising for commercial application.

Magnetic-disk recording changes bits directly with low-flying read/write heads. Until now, no one had discovered how to write directly with magneto-optic technology, because optical recording does not achieve its high density with flying read/write heads. Instead, magneto-optic recording is done with a laser beam on a vertically

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netic field to change a bit. This eliminates the difficulties in applying a rapidly changing external magnetic field close to the disk.

Although it has long been common knowledge that the demagnetizing field can be used to write a bit, no one thought it could be used to erase a bit. But the nucleated domain—the region of reversed magnetism—is large enough in relation to the thickness of the medium for its demagnetizing field to do so. The demagnetized field has the strength within the inner regions of the nucleated domain to override the opposite demagnetizing field in the surrounding material, which means it is strong enough to erase the domain.

When the material of the nucleated domain is heated with a laser beam with a Gaussian heat distribution—that is, hottest in the center—the demagnetizing field in the domain's center has more influence than the opposite demagnetizing field in the material surrounding the domain. The heating and the demagnetizing fields create a smaller reversed domain in the center of the nucleated domain.

This yields two sets of domain walls that move together and collapse, leaving the entire domain with magnetization in the same direction as the surrounding material (see figure). In other words, the nucleated domain is gone—the bit is erased. The laser pulse for erasing must be shorter than the pulse used for writing, otherwise the domain would renucleate instead of being erased.

This process is a simple idea, and the researchers have proven that it works. Yet, like many simple ideas, no one thought of it before CMU graduate student Han-Ping D. Shieh presented the idea to Mark Kryder, professor of electrical and computer engineering and director of the university's Magnetism Technology Center. "At first, I was skeptical," Kryder says. "But then I told him to check it out." Together, Shieh and Kryder proved the theory.

The basic theoretical physics does not require that the compensation temperature, T_c , be above the ambient temperature. However, the researchers found empirically that the compensation temperature should be a few tens of degrees higher, in the range of 60° to 80° C, Kryder says, because the coercivity has a steeper fall just above T_c . Raising it means that T_c is closer to the temperature of the erasing laser beam, and the coercivity drops faster. This seems to be crucial for erasure without renucleating the domain. To raise T_c requires only a small change in the composition of the recording medium, which can be done by altering the ratio

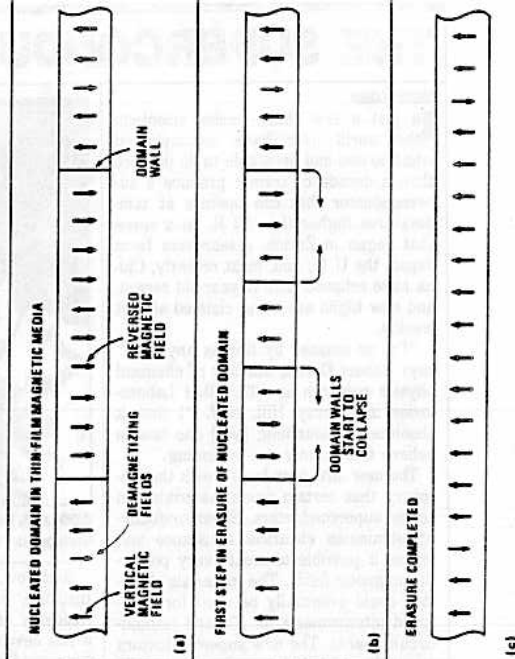
of the recording medium, which can be done by altering the ratio

of the rare earths used in the formulation of the medium. This new medium is no more difficult to make than current media.

A read-before-write scheme was chosen for the direct-writing process. Two laser beams or one split beam can be used. The first beam reads the data on the disk, and a circuit compares this data stream with the incoming write data. The second beam, the changing beam, either erases or writes the bits needed.

This technology is not yet being used commercially. The research was done under contract with General Electric Co., which holds the patent. The technology is being evaluated by a number of companies in the magneto-optic disk-drive business, says Kryder, and it appears that commercial applications are very feasible. The technique works well at high data rates. And in the materials made and tested so far, the researchers have been able to pulse the laser at 10 MHz. Using NRZI coding, they produced a bit rate of 10 Mb/s. With 2-7 run-length-limited coding, they raised the bit rate to 15 Mb/s. Kryder believes that up to 20 Mb/s is possible. These rates compare favorably with current magnetic disk drives.

Computer systems makers and users have been waiting for erasable read-write optical disk drives ever since optical disks were invented. Several schemes for these drives—magneto-optic, phase change, and dye polymer—are under investigation [Electronics, May 19, 1986, p. 30]. The CMU discovery may be the development that puts magneto-optics ahead in the race. The technology that gets to market first is likely to survive the longest. Magnetic recording may at last have an optical challenger to its supremacy.



HEAT TREATMENT: Heating the nucleated domain with a laser creates a reversed domain within the nucleated domain. The domain walls collapse, changing the magnetization and erasing a bit.

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WEST GERMANY GRABS THE LEAD IN X-RAY LITHOGRAPHY

Researchers now produce submicron devices, moving ahead of the U.S. and Japan

by John Gosch

In the international race to make X-ray lithography an important submicron semiconductor technology of the 1990s, West Germany is running well ahead of the pack. Working together under a government-sponsored project, chip makers and systems producers are developing new techniques and equipment—and they've used them to fabricate the first devices made with X-ray lithography.

Although only a year ago it looked like a close three-way race between Germany, Japan, and the U.S. [*Electronics*, March 17, 1986, p. 46], the Germans' reported progress since then indicates that they have pulled into the lead. The West Germans claim they are now one to two years ahead of the rest of the world.

X-ray lithography's strength is high image resolution, down to 0.1 μm (see fig. 1), which makes possible new generations of denser integrated circuits. The technology could become vital to progress in the semiconductor industry in the early 1990s, when 16-Mb dynamic random-access memories hit the market. The chips made by teams from leading West German semiconductor makers do not yet demonstrate X-ray lithography's full potential, but the teams are already on their way to producing devices that can

be used in practical applications.

The Germans have also developed the first version of the special wafer stepper needed for X-ray lithography and are working on a second stepper for production environments. A vertical stepper is required, because X-rays emerge from a synchrotron horizontally, and there is no workable way to redirect them. And to deal with the tiny device geometries involved, the stepper must have an automatic alignment system far more precise than existing equipment.

The key to the West Germans' lead over researchers in the U.S. and Japan was their early access to a research synchrotron suitable for X-ray lithography [*Electronics*, March 17, 1986, p. 46]. Another factor is the drive and energy of Anton Heuberger, the leader of the X-ray lithography project and director of the Fraunhofer Institute for Microstructure Technology in West Berlin, which coordinates the national effort.

WORKABLE DEVICES BY 1987

The chips developed by Heuberger's group were fabricated by teams from two leading West German chip makers, Telefunken electronic GmbH and Siemens AG. Telefunken produced high-frequency MOS field-effect transistors with 1- μm gate lengths; Siemens built metal-semiconductor FETs with 0.35- μm geometries for test purposes. Apparently, they are the first devices ever made with a synchrotron-based X-ray stepper. The project's next phase, which is already under way, envisages high-frequency silicon MOS FETs and bipolar transistors with 0.5- μm features and gallium arsenide MES FETs with 0.3- μm lines. These could be ready as workable devices by 1988.

The next stage after that aims at sub-0.5- μm 4-Mb DRAMs, although commercial 4-Mb chips will probably be built with optical lithography—the last generation of optical-lithography chips before X-ray lithography becomes an important alternative. The introduction of 16-Mb DRAMs and other devices with 0.3- μm geometries, in the early 1990s, should signal the emergence of X-ray lithography.

The X-ray source that has been crucial to the project is the Berlin Electron Storage Ring for Synchrotron Radiation, or Bessy for short. Built during the late 1970s for basic research and tapped by various West Berlin research facilities, Bessy has since been modified to accommodate microelectronics R&D. Of Bessy's 30 or so radiation ports, the Institute for Microstructure Technology—situated in an adjacent building—

rents about one fourth for the X-ray lithography project.

In Bessy, X-rays are produced by electrons racing around a storage ring 20 meters in diameter at the speed of light. The radiation is delivered in nearly parallel rays at a power of more than 100 mW/cm². That much power is needed for the high-throughput step-and-repeat equipment, Heuberger says. The level is adjustable for different sets of masks and resists.

A radiation source of the size and cost of Bessy is, of course, impractical for use in semiconductor production at a company's premises. So, for production-line applications, a compact synchrotron storage ring, called Cosy, is now in development at the West Berlin Institute. It will be built and marketed by Cosy Microtec GmbH of West Berlin [*Electronics*, May 26, 1986, p. 15].

An even less-expensive alternative is the plasma X-ray source under development at Karl Suss KG, of Munich. However, Suss's LSX 10 is only for laboratory R&D work and small-scale device production. Its exposure time will be on the order of minutes rather than seconds, and the depth of focus will be much smaller than that obtainable with Cosy. A prototype of the LSX 10 will be ready during the first half of this year.

Even without low-cost X-ray sources, the West Germans have passed the pure-research stage: components built with X-ray lithography at the Institute can already be used in practical applications. The 1- μm -gate MOS FETs made by a team from Telefunken in Heilbronn are n-channel dual-gate devices on a 0.5-by-0.5-mm chip (see fig. 2). Although the 10,000-odd devices that Telefunken fabricated last year are mainly for tests and evaluation, the company is offering them for use in, for example, tuners, mixers, and amplifiers for radios and television sets. The working chips arrived about a year ahead of schedule—"a result of shifting our priorities and doubling the manpower assigned to the development effort," says Gerhard K. Lüssing, manager for process engineering of discrete devices at Telefunken.

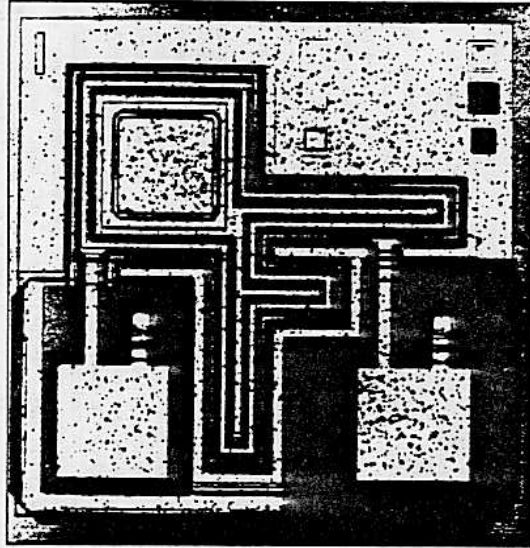
In these devices, X-ray techniques are applied to only one of the 10 or more masking steps—the most critical one, opening the gate stripes. All other steps rely on conventional photolithography. "Using the still-costly X-ray processes for noncritical steps for which the less-expensive standard methods will do is not economical," Lüssing declares. However, the 0.5- μm MOS FETs Telefunken will have ready by the end of this year will have two X-ray masking steps, and future bipolar devices and high-density memories will have five and more.



HEUBERGER. The head of West Germany's X-ray lithography project sees a payoff in the 1990s.

vehicles employed for measuring parameters, determining yields and optimum exposure conditions, and investigating defects. "We are now developing and optimizing test devices with 0.3- μm gate lengths," says Karl-Heinz Müller, a laboratory manager heading the Siemens team at the Institute. Besides device fabrication, Siemens will supply the superconducting magnets for the Cosy compact synchrotron.

An important part of the X-ray lithography project is work on X-ray resists and mask technology. Masks for X-ray work are hard to make, because no known material is transparent to X-rays in relatively thick dimensions, as glass is to light. Researchers are also looking for materials that block X-rays despite very thin dimensions. Telefunken, the Institute, and the AEG Research Laboratories in Ulm have jointly developed a boron- and germanium-doped silicon membrane



2. UNDAUNED. Telefunken has built about 10,000 n-channel dual-gate MOS FET chips using one X-ray lithography step to check for radiation damage.

DEC MARCHES ON: NOW A DESKTOP VAX

BOSTON Cover the namplate and what was announced in Boston last week was just another 1-million-instructions-per-second and work station for about \$10,000. But then their fear of the cover and get ready for the impact of the first desktop VAX computer.

That the fully VAX-compatible machines—the VAXstation 2000 and the multiuser MicroVAX 2000—will have significant impact is apparent from DEC's announcement that it begins public marketing of the products with orders in hand for 5,000 units. Shipping in April, the small computers will also have a big head start on IBM's mid-

range 9370, which will not be fully ready to compete until later this year. But whether the machines will cause major disruptions in the work-station market per se is another matter, and one that depends heavily on the improv-

The new computers clearly continue the unprecedented pace of major product announcements that DEC has maintained for the past two years. They also represent an historic milestone in that the power of the first refrigerator-sized VAX introduced a decade ago has now been compressed into a box smaller than an unabridged dictionary.

To create the 2000 line of computers, DEC downsized a MicroVAX II into a

The VAXstation 2000 is being thrust into a burgeoning low-end workstation market. Dataquest Inc. estimates the reducing the system's electronics from four boards to just one—which carries more than a dozen new custom CMOS

to company-wide standardization of computers, those engineering departments will be under pressure to look closely at the low-cost VAXs to tie in with IBM machines elsewhere.

—Craig R. Smith

Could it be your next PC?

Nearby supernova

Astronomers at the Cerro Tololo Interamerican Observatory at La Serena, Chile, discovered a supernova in the Large Magellanic Cloud on the morning of Feb. 24. This is the nearest known supernova to us in almost 400 years and apparently the first in that time to be visible to the naked eye. From the Southern Hemisphere, it should be the brightest star in the sky. It will not be visible from most of the Northern Hemisphere. □

Higgins' culpable supernova SN, 2/28

BOSTON Cover the nameplate and what was announced in Boston last week was just another 1-million-instructions-per-second and work station for about \$10,000. But then tear off the cover and get ready for the impact of the first desktop VAX computers from Digital Equipment Corp.

That the fully VAX-compatible machines—the VAXstation 2000 and the multiuser MicroVAX 2000—will have significant impact is apparent from DEC's announcement that it begins public marketing of the products with orders in hand for 5,000 units. Shipping in April, the small computers will also have a big head start on IBM's mid-range x370, which will not be fully ready to compete until later this year. But whether the machines will cause major disruptions in the work-station market per se is another matter, and one that depends heavily on the importance customers attach to the nameplate on the computer.

The new computers clearly continue the unprecedented pace of major product announcements that DEC has maintained for the past two years. They also represent an historic milestone in that the power of the first refrigerator-sized VAX introduced a decade ago has now been compressed into a box smaller than an unabridged dictionary.

To create the 2000 line of computers, DEC downsized a MicroVAX II into a package measuring 1 ft by 1 ft by 5 in. and cut the price in half. This required reducing the system's electronics from four boards to just one—which carries more than a dozen new custom CMOS chips—all designed and built by DEC.

DEC's most extensive use of surface-mount technology to date helps pack 4 megabytes of memory into a space 4 by 7 in. And power consumption is half that of the MicroVAX II machines, falling to 160 W for the 2000 line.

BROAD LINE. The new products now stretch DEC's VAX computer family from an entry-level desktop MicroVAX 2000 priced at \$11,100 to the largest clustered VAX 8978 at nearly \$4.9 million. Included in the purchase price of both new 2000s is a one-year warranty providing on-site hardware support and telephone software support.

The rapidly expanding VAX line—with the appeal of hardware compatibility, extensive applications, and software portability—is enabling DEC to build market share at the expense of other minicomputer vendors and its primary rival, IBM, whose various products run several incompatible operating systems.

19 February

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wafers up to 8 in. in diameter, the XRS-200 stepper, when used with Cosy as the X-ray source, will have a throughput of twenty 6-in. wafers per hour for 25-by-25-mm step-and-repeat fields.

The XRS-200 is now undergoing tests. The first system will be installed in the Institute's pilot line by May. The machine will be employed for research on 4-Mb DRAMS with 0.5- μ m features and "could pave the way for 16-Mb DRAM production," Callmann says.

Suss will start taking orders for the XRS-200 in 1987 and hopes to deliver the first systems toward the end of the year. At a cost of \$800,000 to \$1 million, the XRS-200 alone will sell for less than an optical stepper, Cullmann says. The

Cosy synchrotron storage ring is expected to sell for around \$6 million. The stepper's price, plus the cost of a share in a Cosy ring, is than \$2 million when the maximum users are operated on one ring.

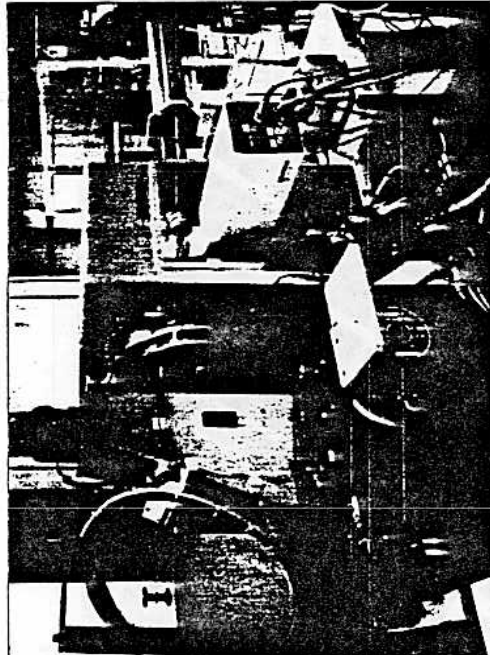
the stepper's ability to transfer sub- μ m features into the wafer is its alignment system. To handle the increasing number of mask layers, the system must operate with an adjustment tolerance of $\pm 1 \mu\text{m}$. With an adjustment tolerance of $\pm 1 \mu\text{m}$, it must be able to cope with the nonuniform mask-to-wafer disalignment X-ray-resist thicknesses, and the nonuniformity of the contrast volume of the resist.

the contrasts of alignment patterns have problems and to meet the accuracy requirements, Siemens developed a new alignment system with an accuracy around 20 nm, which the company claims is the best such a system has ever done under such conditions. The aligner on offer reaches the 20-nm accuracy in Siemens is working on a version for that can reach the same accuracy in

Siemens system implements a light-optical technique based on image processing. It is a recognition, rather than on the interpolation approach commonly used in alignment systems. Instead of evaluating diffraction orders, Siemens system processes an optical grey-scale levels.

metrical multiple-alignment patterns on a wafer consist of crossed lines that form a grid of squares. The aligner is a system of lenses that project the alignment patterns onto the targets of charge-coupled devices (CCDs) in the subsystem controller. The outputs of the subsystem controller are used to drive the electrostatic actuators that position the wafer.

Electronics / Equipment E 1097



3.3. FIRST STEPPER. Karl Suss KG built the Max I vertical water stepper for X-ray lithography work, and Siemens developed its high-precision alignment system.

that carries a gold X-ray absorber pattern.

Meanwhile, the Telefunken affiliate Eurosil GmbH in Munich is trying out a membrane consisting of silicon nitride and is investigating gold and tungsten absorbers. The Philips subsidiary Eurosil GmbH, Hamburg, is looking at silicon carbide for membranes and gold and tungsten as absorbers. The Institute will evaluate these membranes and absorber materials.

Besides access to Bessy, another important boost to the West German efforts was the availability, starting in 1984, of an X-ray stepper developed by Karl Suss, which both Siemens and Telefunken used to fabricate their devices (see fig. 3). The Suss machine was the first stepper designed to work with a synchrotron radiation source, according to Edmar Cullmann, senior scientist for R&D at the Munich-based company, although IBM has since built a similar machine.

Designated Max 1, the stepper uses a step-and-repeat approach, which Cullmann says is necessary to obtain the mask-to-mask overlay accuracy—better than 0.1 μm —required for sub-micron design rules. All coarse motions of the wafer relative to the mask (in rotation and in the x and y directions in the wafer plane) are on air bearings and are induced by the step motor in 0.4- μm increments. Fine alignment is done with a 10-nm piezoelectric stage that moves in 10-nm increments. A second piezoelectric stage rotates the mask. Wafer exposure takes about two seconds and can be done in a conventional air environment—no sealed chamber is necessary, as it is with optical lithography.

Although Max I was developed primarily for experimental work, Suss is now building another model that is intended for volume production work. With its cassette-handling capability for